

SUMMER 90-91

21-C

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PREVIEWS OF A CHANGING WORLD

PORTRAITS OF 41
AUSTRALIAN MAMMALS
FACING EXTINCTION
FORESTS 1780S & 1980S
COULD SUPER FUNDS
SOLVE FOREIGN DEBT?

THE PLANETS: A SURVEY OF NASA SPACE PHOTOS



HUMAN DNA
COMPUTER ART
MEMORY RESEARCH
HONG KONG 1997
RISING VIOLENCE
GREEN ECONOMICS



FUTURE VISIONS

ROBYN WILLIAMS

ALEX PUCCI • MARK SEYMOUR

PETER GARRETT

ANNA BOOTH • JOHN SPALVINS

JUDITH WRIGHT

DAVID DALE • MARY FALLON

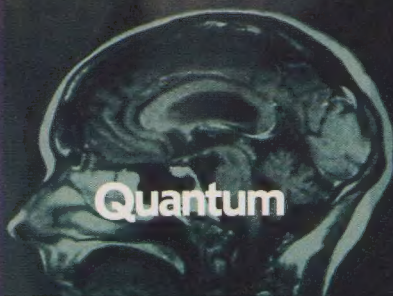
BARRY JONES



TO PLANET EARTH
TO PLANET EARTH
TO PLANET EARTH



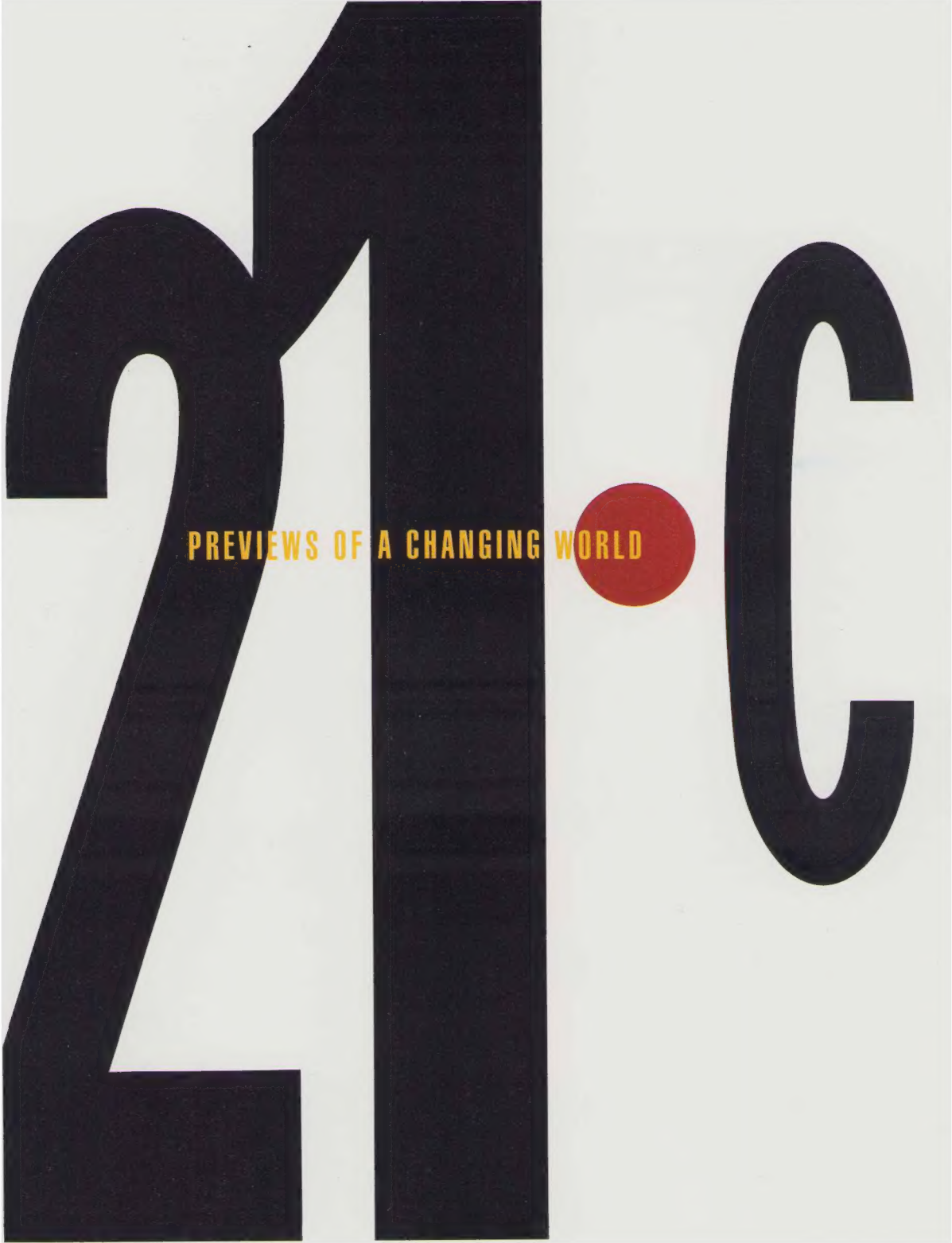
PETER WHERRETT - FUTURE CARS



Quantum

COMMISSION FOR THE FUTURE





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COMPUTER ART

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Maree Woolley

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The Commission for the Future
The Commission for the Future serves as a national focus for information on the future. Its job is to research long-term trends and issues, and communicate options for the future to decision makers and the public.

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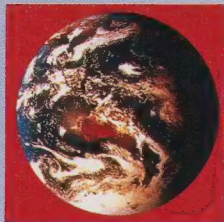
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POPULATION

- The Australian population is ageing. In 1901, people over 85 totalled four per cent of the population. By 1990, they made up 10.5 per cent, and this is expected to rise to 16 per cent by 2030.
- Melting pot: 22 per cent of Australians were born overseas; 30 per cent have parents who were born overseas, and a further 12 per cent have one foreign-born parent.
- The number of people per household has fallen from 4.5 in 1911 to 2.8 in 1988.
- The birth rate continues to decline and is now 12 per cent below the rate required to maintain the present population.
- Life expectancy for Australian men is now 72 and for women 79, an increase of 40 per cent since 1901.

EDUCATION

- Enrolments in technical education have tripled since 1970.
- During the 1980s, the proportion of students staying at school until year 12 rose from 34 per cent to 60 per cent. There was a corresponding 30 per cent increase in students undertaking advanced education.
- Numbers of government schools and enrolments are falling, while numbers of non-government schools and enrolments are rising.

WORKFORCE

- Real wages fell 4.7 per cent between 1985 and 1987, and a further 1.9 per cent from 1987 to 1989.
- 15 per cent of Australians depend on government benefits, and this is likely to rise to 24 per cent by 2020.
- The number of working days lost through industrial disputes fell by 35 per cent during the 1980s.
- Since the mid-1960s, women's participation in the workforce has increased by nearly 70 per cent.
- Between 1910 and the 1980s, employment in rural enterprises fell from 25 per cent of the workforce to six per cent; in mining from six per cent to one per cent; and in manufacturing from 21 per cent (29 per cent in 1950) to 18 per cent. Meanwhile, jobs in service industries grew from 48 per cent to 75 per cent. There are now more people employed in the community services sector than in manufacturing.

BUSINESS

- Small businesses of up to 20 employees account for more than 95 per cent of all business enterprises in Australia, and more than 50 per cent of all employment in the private sector.
- During the 1980s, women started up twice as many businesses as men. Women's businesses survive longer but are less successful in terms of income and profit.
- Convenience is increasingly becoming a feature of goods and services. For example, home delivery in the fast food business now accounts for eight per cent of the market.
- Consumer interest in environmentally friendly products is growing. One survey indicates that 75 per cent of consumers would pay more for food in packaging that does not harm the ozone layer.

NEXT TRENDS AND INNOVATIONS



SPACE HOTEL

Been everywhere? Done Antarctica and the Amazon in a rubber dinghy?

In 30 years or so, those with around a quarter of a million dollars to spare could be able to zip out of town for a relaxing weekend in space.

The Japanese construction giant Shimizu is planning a solar-powered space hotel that would orbit 450 kilometres above the Earth.

It would have 64 rooms arranged like a doughnut around a central

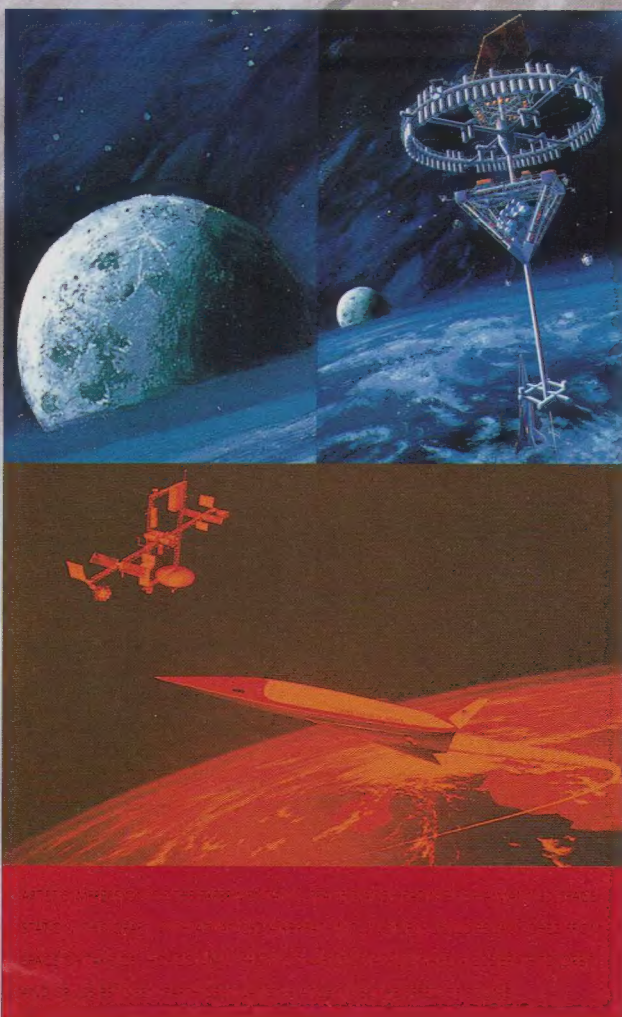
core, with a control centre at one end and a docking facility for space planes at the other.

Artificial gravity of 0.7 G would be created by rotating the structure three times a minute, allowing normal use of facilities such as toilets and showers. Air would be cleaned by algae.

Tourists would depart Earth from a base probably located near the equator in the Pacific region.

Space planes able to ferry passengers to a future space hotel are already being developed. A US consortium of government agencies and aerospace companies has earmarked \$US 2 billion to build an aircraft that would fly at 25 times the speed of sound.

It would cut the flying time between New York and Tokyo from 14 hours to two.



SHIMIZU

ART SPACE

In the footsteps of Arthur C. Clarke, who once proposed an artwork of lasers projected on the moon, artist Arthur Woods of the Swiss OURS Foundation has created a sculpture destined for a brief life in a unique gallery.

Woods' 10-metre sculpture will be launched by a Soviet rocket in 1992 and filmed by the Mir space station before breaking up a week later.

The implications for the expansion of advertising into space are disquieting. Do we really want laser images of Macburgers or orbiting Coke cans in the night sky?

DATELINE: SPACE

A Japanese television journalist will be aboard the Soviet Soyuz spaceship when it is launched into Earth orbit in December.

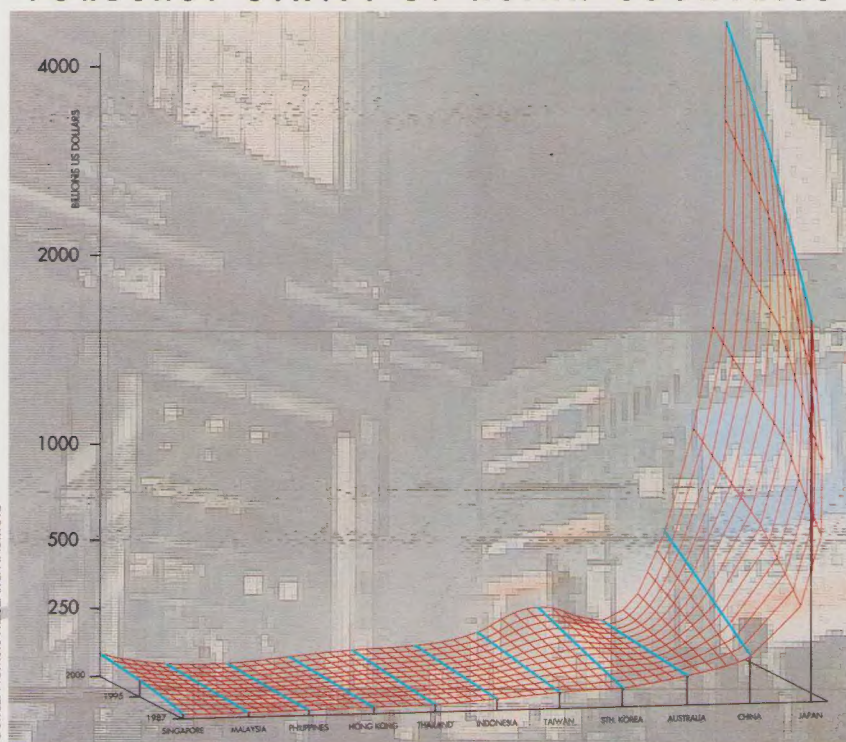
Tokyo Broadcasting System, Japan's largest private broadcaster, has two journalists in training for the assignment. One will spend eight days in space and make daily reports on features of the Earth's environment.

Ms Ryoko Kikuchi and Mr Toyohiro Akiyama, who were selected from 163 applicants, will also report live during the rocket launch.

Head of TBS News, Mr Hiroshi Ohta, says that while it is company policy not to pay for interviews, TBS would pay the Soviet Union one billion yen for the story.

FORECAST G.N.P. OF ASIAN COUNTRIES

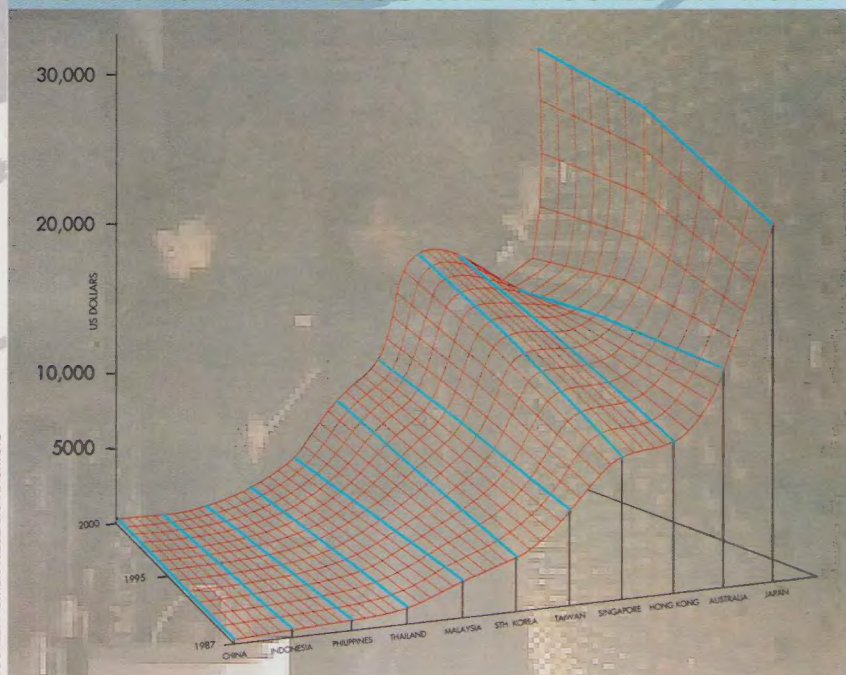
SOURCE: NOMURA RESEARCH INSTITUTE



DECLINING PROSPECTS: AUSTRALIA'S ECONOMIC OUTPUT (GROSS NATIONAL PRODUCT) IS FORECAST TO FALL FROM THIRD HIGHEST IN THE ASIAN REGION IN 1987 TO FOURTH BY THE YEAR 2000 (ABOVE); SECOND HIGHEST IN PERSONAL INCOME IN 1987 AUSTRALIA IS PROJECTED TO FALL TO FOURTH BY 2000.

FORECAST OF PERSONAL INCOME IN ASIA

SOURCE: NOMURA RESEARCH INSTITUTE



CHANGE IN AVERAGE GLOBAL TEMPERATURE (ANNUAL AVERAGE)

SOURCE: IPCC



FUTURE PHONES

You've read the cartoon; you've seen the film; now get the watch.

The "Dick Tracy" two-way wrist watch may not be that far away.

Technology forecasters believe that early next century, portable, cordless, personal communicators will be widely available, and it is feasible that they will be small enough to wear. Users could be allocated an individual telephone number that would remain theirs for life.

The technology for this kind of communicator is already on its way. More than 170,000 mobile cellular phones use Telecom's MobileNet system. And Telecom says that 60 per cent of phone calls will have a mobile component by the end of the 1990s.



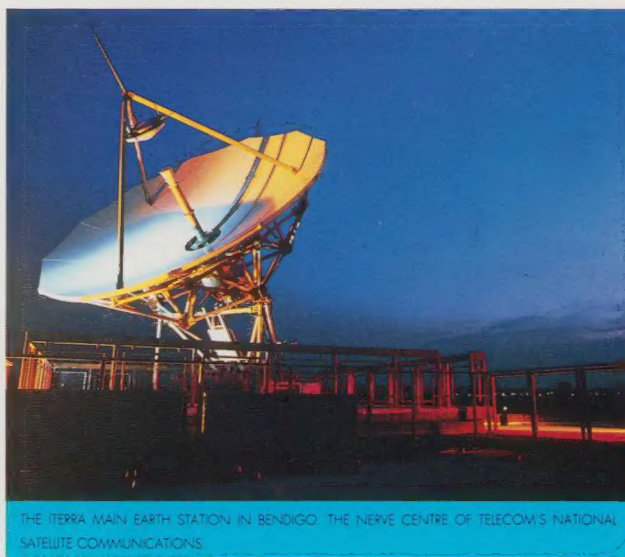
THE ORIGINAL DICK TRACY.

MobileNet reaches 75 per cent of Australia's population, but only one per cent of its land area. Advances in satellite dish technology mean that when the new Aussat communication satellite is launched, all of Australia will be covered.

Cellular and satellite mobile phone technologies are not the only mobile means on the horizon. In Britain, a highly portable phone system called CT2 allows the user to carry a cordless phone in their pocket.

The CT2 phone is about the size of a pocket calculator and can be used within the operating radius of the radio base stations at busy sites, such as shopping centres, construction sites and airports.

Future phones will not only be mobile, they will also be "smart". You will be able to instruct the phone to store calls or put them in a queue. And you will be able to "hide" from people you don't want to speak to.



THE ITERRA MAIN EARTH STATION IN BENDIGO. THE NERVE CENTRE OF TELECOM'S NATIONAL SATELLITE COMMUNICATIONS.

TRENDS AND INNOVATIONS

NEW PRODUCTS

ELECTRONIC DELIGHTS

A big seller in Japan is a 10 cm, battery-powered "weather cube" that predicts the weather eight hours in advance. A boon for travellers is the SUS2000 portable, voice-activated translator that can recognise more than 35,000 sentences. You speak to it in English and your words come back, for example, in Japanese. During a tour of the Fujitsu plant in Japan last year, British PM Margaret Thatcher's opening remark: "I am glad to have the chance to be in Japan," was spoken in Japanese into the company's latest translator and came out: "It's a pleasure for me to be in Japan." Close. Epson makes a 16 cm automatic dictionary for US\$230 that translates 31,000 words by "reading" a Japanese word and displaying the English equivalent. Toshiba recently announced a word processor that functions in much the same way as the neurons in the human brain. It is self-taught and makes intelligent guesses. Likely by 1995 are 10 cm displays set into the back of aircraft seats, allowing passengers to choose their own in-flight entertainment and information. Also likely is the VoiceKey that uses individual voice patterns to unlock doors; an electronic bandage that promotes healing by pulsing radio waves into the wound; and a birdfeeder with a two-way mirror that allows you to watch the birds without them seeing you. New from Konica is the Kanpai camera that has a shutter release coupled to a built-in microphone, so that, at a pre-set sound level, the camera automatically starts clicking away, while rotating randomly on a tripod. Handy for candid party snaps.



POLLUTANT DETECTIVE

CSIRO scientists have developed a monitor that could revolutionise the management of smog. The device, called Airtrak, can measure the main components of photochemical smog and track the pollutants back to their source. It can also predict the build-up of smog and its likely path, and give early warning of dangerously high levels. Photochemical smog is produced by a chemical cycle in which light reacts with various components in the air — particularly certain hydrocarbons — to produce ozone, nitrogen oxides and nitrogen-based chemicals. Airtrak could help town planners to decide where to locate new industries based on the predicted impact of industry emissions.

SPACE EMERALD

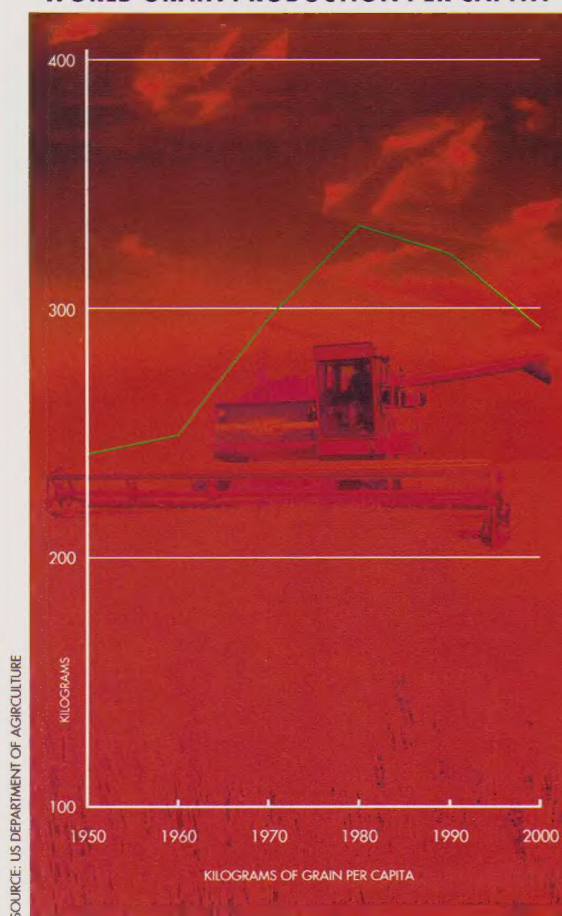
Even in the driest conditions, the Space Emerald from High-Life NKK only needs water once every one to three months. This product of biotechnology comes in an ion-exchange resin soil.



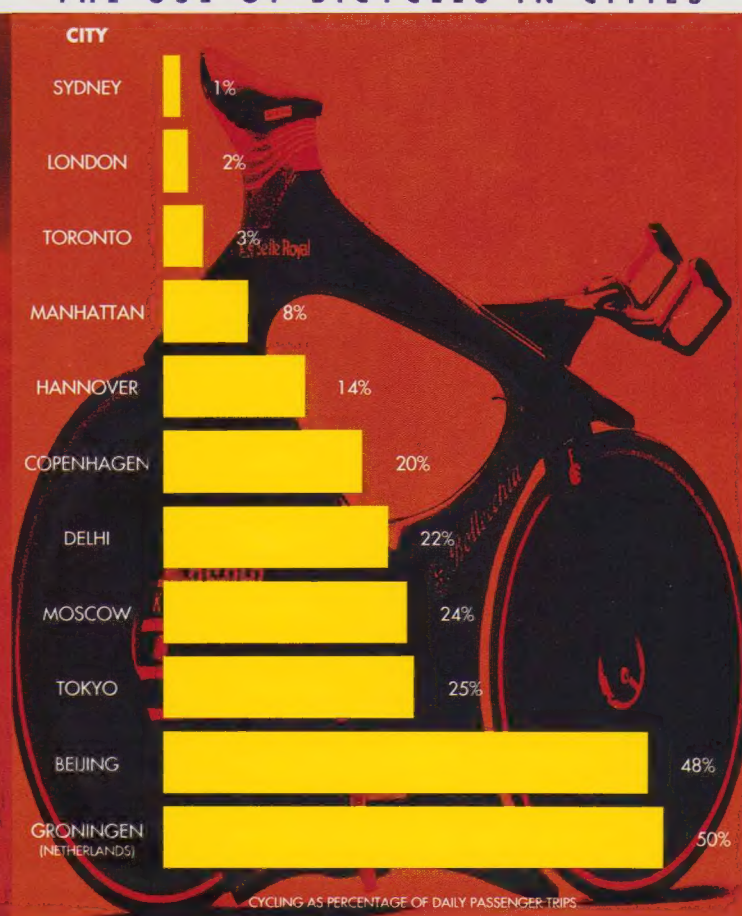
Continued page 10



WORLD GRAIN PRODUCTION PER CAPITA



THE USE OF BICYCLES IN CITIES



JUNGLE NOISES

Australian technology is giving gorillas in the San Diego Zoo a first aural experience of their natural rainforest habitat.

Melbourne's Sound Design Studio is simulating the sounds of an African rainforest at the zoo to provide information to visitors and peace of mind for the gorillas.

The installation utilises a multi-layered ambient soundtrack, coupled with visual information displays and "intelligent" devices that can be triggered by visitors.

The system can also interact with itself — like an independent technological organism.

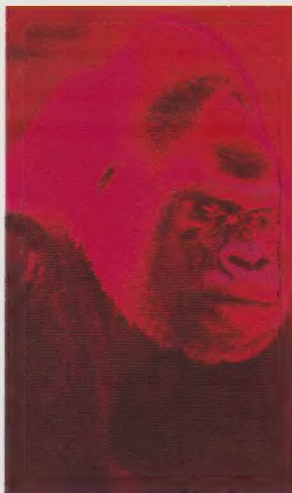
Les Gilbert, director of Sound Design Studio, has worked with animal psychologists to use sound as a positive force in the lives of captive animals. All gorillas living in the zoo have been bred in captivity.

"These animals are living with sounds that are completely alien to them — clanging iron gates, loudspeaker address systems and muzak," Gilbert says.

"We want to create an environment that engenders physiological responses in the gorillas to the sounds of other animals; that makes them feel more at home."

He has had to be careful to avoid sounds that would disturb the gorillas and is working with zoologists to make sure the right sounds are used.

Gilbert believes the San Diego project will change the ways zoos house and care for animals in future.



SALTY TREES

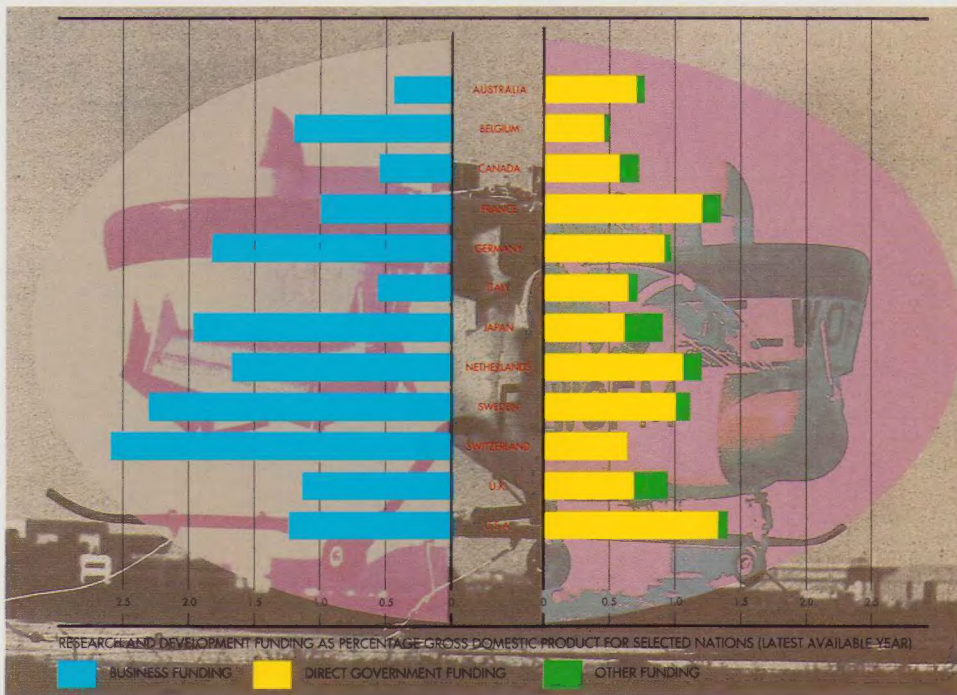
Trees able to grow in high salt areas offer hope to Australia's degraded soils.

Half a million hectares of Australia's most productive land — along with more than one-third of the world's irrigated areas — are affected by soil salinity, a condition fatal to food crops.

The project is being developed by CSIRO, the University of Western Australia, Murdoch University and the private company Plantex.

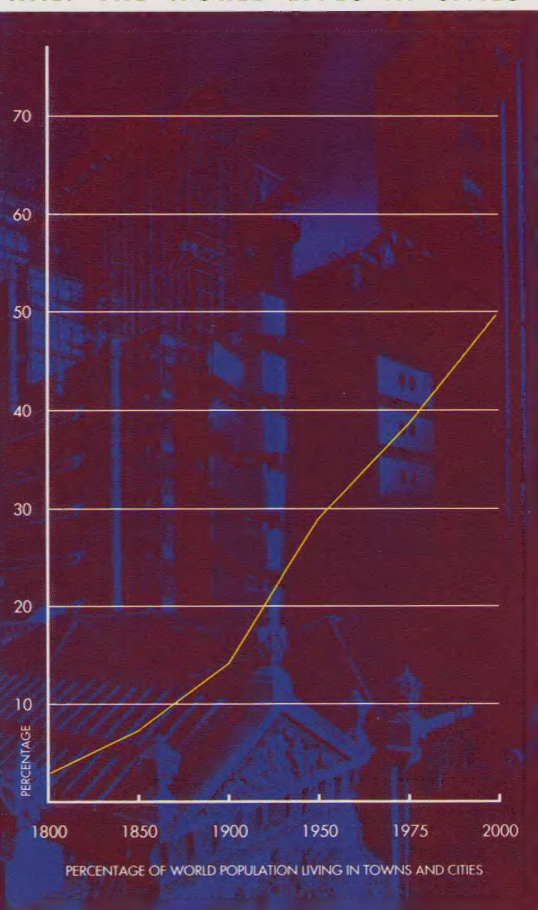
The salt-tolerant trees, produced by selective breeding, help to reclaim salty soils by lowering the water table. If, when mature, these trees yield useful timber for paper pulp or fence posts, they would help to return saline land to productivity. Already 50,000 trees have been sold on local markets. Export sales look promising with many countries showing interest.

EXPENDITURE ON RESEARCH AND DEVELOPMENT



TVS PER 1000 PEOPLE

HALF THE WORLD LIVES IN CITIES



INNOVATOR: MARGARET WERTHEIM

SCIENCE IS SEXY

SYDNEY FILM AND videomaker Margaret Wertheim, 31, is bringing a fresh approach to the task of communicating scientific ideas.

Last year Wertheim, a leader in the emerging field of interactive video, won a Canadian award for the best interactive video disc of 1989 for a 30-minute disc on AIDS she produced in Canada for distribution in North America.

She is presently making a six-part series of science programs for ABC-TV called *Catalyst* and aimed at young people.

With *Catalyst* she is trying to present science the way she saw it as a young girl. "I loved science and always saw it as a thing of beauty," she says. "As something that is wonderful for its own sake, not because you have to learn it. In this series I am trying to encourage kids — particularly girls — to see science in a new way and get excited about it." Her message is that science can be sexy; that girls can have physics — and fun, too. "When they hit puberty, girls generally turn off science," Wertheim says. "Their most important interests become their sexuality and attracting boys. They think science isn't sexy. I want them to see that you can be a cute, sexy, hip 14-year-old and still be good at science."

Wertheim was commissioned to produce the AIDS video disc by Canadians who had been impressed by a disc she made for the UN pavilion at Brisbane's Expo 88. It is being shown in hospitals, community centres and workplaces in Canada and the US.

"I tried to approach the subject from a very humane point of view," she says. "The main thrust was how to avoid AIDS and how to deal with the situation if you knew someone who had it. It dealt with safe sex — what it is, how to have it, how to bring up the topic with your partner."

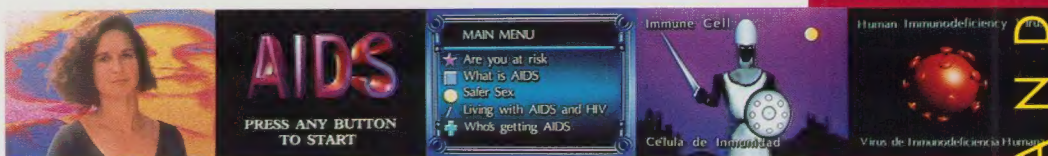
An interactive video disc is a large compact disc with sound and vision run by a computer program. Viewers can select which parts of the 30 minutes of material on the disc they wish to access.

The challenge of the form is to condense the content into small information parcels, much like chapters in a book, while keeping the viewer's interest by giving them many opportunities to interact using a simple keyboard.

Wertheim met the challenge by making what she calls "50 short commercials" on topics such as how to use a condom and how the virus is transmitted from a woman to her unborn child.

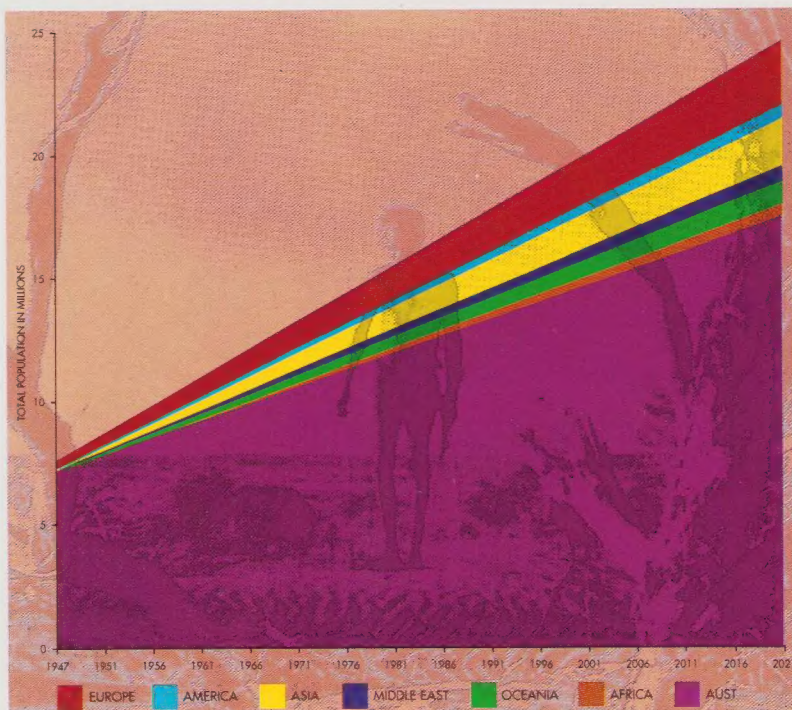
She feels the technology is an exciting new form of communication, ideal for expos and museums, but limited by its cost

(\$200,000 to produce the AIDS disc) as a popular education tool. "It is going to take a while to bring the cost down and increase the disc time from its present 30 minutes," she says.



Wertheim is committed to bringing beautiful images into her work, no matter how tough the subject matter, and to relating science to everyday life. "Exploring beauty, communicating ideas about science and expressing this in film — that's how I want to spend my life."

AUSTRALIA'S POPULATION BY BIRTH PLACE TO 2021



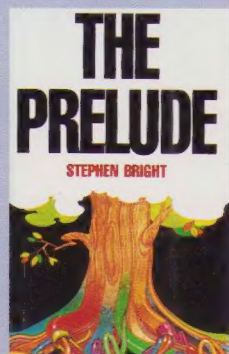
NOVEL APPROACH

Telecom has released an innovative management training manual in the form a novel called *The Prelude*.

Set in 1999, the story tells how an Australian communications corporation fares in a deregulated environment, and the difficulties it faces in implementing real structural change.

Author Stephen Bright says: "Change for organisations or individuals can be seen as challenge or threat. All too often we forget about the 'opportunity' part of the equation. I have tried to talk about the opportunities which lie ahead for organisations willing to peer over the infinite-event horizon of technological and social development."

The *Prelude* has been awarded the Australian Society of Business Communicators' Gold Seraph Award for excellence in communication.



FLUORO LIGHT GLOBES

Compact fluorescent light globes could be an important light source in future. They have the same light output as conventional incandescent globes, but use only about one-fifth the electricity and last up to 10 times longer.

The State Electricity Commission of Victoria has bought 30,000 of these energy-efficient globes, helping to make them available through major retailers at a reasonable price.

Compact fluoro globes are made with different colour properties — warm colours for domestic use and cool colours for commercial applications.

The SEC is also planning a \$15 million, 10-megawatt pilot wind farm of 30 to 50 Australian-made windmills on Victoria's south coast.

CLEAN COAL

A prototype factory to produce "clean" coal is being developed by the NSW Government, industry and CSIRO. The consortium hopes the plant will produce superior coals, tailored to meet the needs of increasingly environmentally aware industries overseas.

Clean coal would have a lower ash content and give off less sulphur and carbon dioxide.

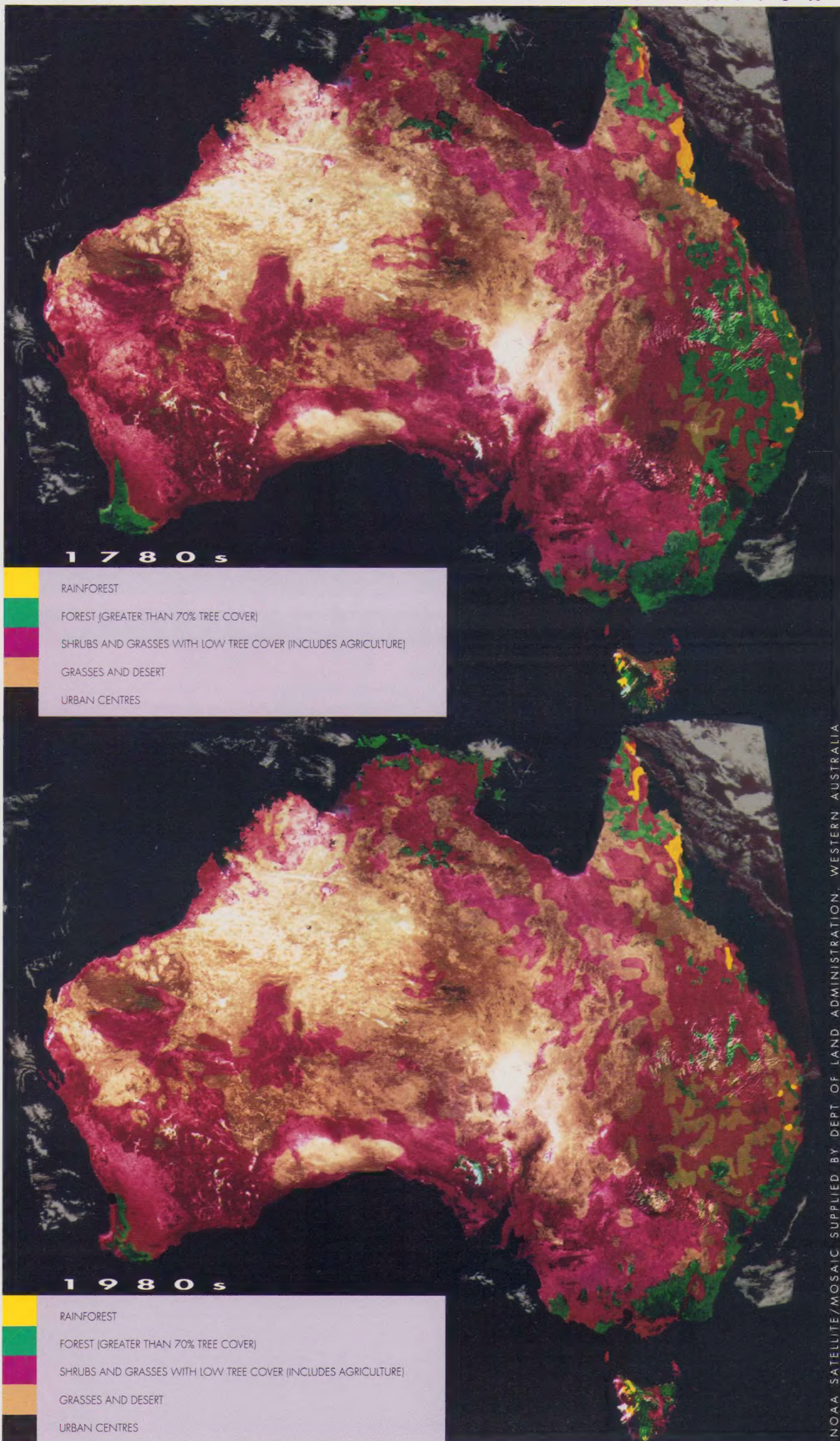
CARDBOARD CLOSET

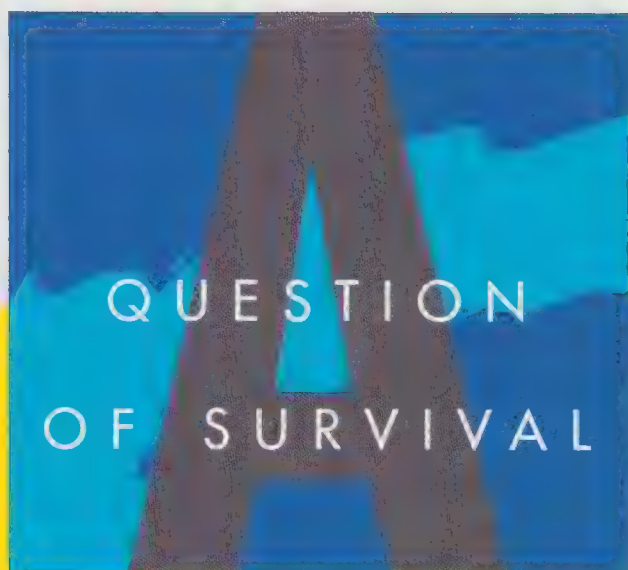
If the Centre for Design at the Victorian University of Technology has its way, the next chest of drawers you buy could be made of cardboard.

The cardboard furniture was built by young designers at the centre who are looking at ways of producing high-quality products that are environmentally friendly.



A U S T R A L I A ' S C H A N G I N G V E G E T A T I O N





SECURITY GUARD

The ABC-TV *Quantum* crew filming recently in the Jenolan Caves Reserve found themselves continually interrupted by a persistent car alarm. After an unsuccessful search for the guilty automobile a ranger informed them that the sound was coming from an impudent lyre bird who'd taken to mimicking familiar sounds in the reserve. The fact that its repertoire also includes the sound of chainsaws and trail bikes is cause for some alarm. However, with the vigilant lyre bird on the job, the presence of interlopers abusing the forests will not go unnoticed.

SAFE BEHIND THE FENCE

Australia's track record for losing its native species is hard to beat, with half the mammals that have become extinct worldwide in recent years being our own. To redress this alarming situation, captive breeding programs have been introduced with some success, and further good news is the opening of the Yookamurra Mallee Sanctuary in South Australia.

Thirteen hundred hectares are being fenced off to keep out introduced pests like rabbits, foxes and cats that outcompete our native fauna, in preparation for a four-year program to reintroduce animals which once flourished in the Murray Mallee—numbats, bilbies, barred bandicoots and quolls. It will take time, but without the imposition of uninvited and unwelcome guests, the future for these little Aussie battlers should be a lot more promising.

TREE TUCKER

With Australia's population hugging the coastal regions it's been too easy for us to dump our waste in the sea and other waterways. In May of 1990, 750 people across NSW suffered serious food poisoning. The cause? Oysters found to be contaminated with high levels of faecal bacteria. Residents of the small South Australian river town of Loxton do not have to contend with such problems. Five years ago the town's sewage was rerouted to feed 60 hectares of river redgum saplings. From then on, every time Loxonites flushed the toilet they helped grow trees. Today the forest is 20 metres high, standing as a monument to a good idea.

NUTS AND GENES

The applications for genetic engineering are many. A project is underway in Brazil where scientists are attempting to blend the nutritional qualities of the Brazil nut with the prolific cassava root crop and, in the process, create a cheap but valuable source of protein. With the world's population expected to double by the year 2020, there could be a big appetite for the humble cassava.

NATURAL BUG KILLER

If traditional pesticides are getting up the communal nose, the Neem tree from Burma could provide an alternative insecticide. The magic ingredient, extracted from its seeds, is a natural molecule which kills insects yet is harmless to all other creatures. It's already being used on a small scale, but as yet hasn't tempted big business. That's because it can't be patented. Now Queensland University's Dr Martin

Rice is campaigning for a full-scale Neem industry in Australia to replace conventional pesticides. With supermarket chains crying out for environmentally friendly products, the time for Neem is surely ripe.

COTTON TALE

Still on the pesticide front, the CSIRO'S Division of Plant Industry is attempting to reduce their use in the cotton industry. Using genetic engineering, scientists are transferring a bacterial gene that produces a natural insecticide into Australia's major cotton varieties. This could cut the use of commercial pesticide by 25 per cent.

REFUSE REDEEMED

In the future you might find yourself dining on, or living in structures that are using resources found in abundance at the local tip. The Smorgon Company in Victoria has introduced a range of sturdy outdoor furniture made from recycled plastic, while. While in the US the latest development in the home building industry is the construction of houses made completely from recycled materials, including plastics, aluminium cans and old tyres. This year Australians will discard 10 million tyres, nearly three billion aluminium cans and mountains of plastic. It could all add up to a lot of potential houses, less rubbish and a big saving in dwindling natural resources.

SHOPPING BAGS

Canadian retailers give shoppers incentives to bring their own. In Italy there's a tax on them, and in Australia, aversion to the plastic bag is rising. Many smaller food outlets no longer supply them, while recycling bins are now to be found in scores of supermarkets. The Coles-Myer chain recently threw down the gauntlet, retrieving a relic of a bygone era from the brink of extinction. In May 1990 they introduced handmade, undyed, unbleached string bags in about 200 supermarkets across Victoria.

GREENING THE BOARDROOM

Only a short while ago "greening the boardroom" would probably have conjured up visions of redecorating the office, but these days paint has little to do with it. The business sector is now having to respond to the huge demand for "environmental audits" which assess a company's performance in protecting the environment.

Many banks and insurance companies now require them before committing funds to major projects and prominent law and accounting firms have been quick to set up divisions that advise specifically on environmental issues. In NSW a new credit union has been established with a very green brief, while overseas investors refuse to buy into companies with a poor environmental record.

CHANGING HABITS

Australian Supermarket Institute boss, Bob Parker, wants to conduct an informal survey to determine how concern for the environment is influencing shoppers. If his own

household is an indicator, the results should be interesting. Bob finds shopping with his wife now takes 50 per cent longer because she religiously examines all labels before making her purchases. There's also been a garbage revolution in the Parker household. The single pile of homogenous garbage is no more, having long given way to half a dozen piles, all earmarked for separate destinations, and a flourishing compost heap in the back yard.

GREEN CAUSES RED FACES

Last year 28 per cent of Sydney households bought environmentally friendly products and 24 per cent did so in Melbourne. As it turned out, not all the products proved to be as friendly as their packaging suggested, with manufacturers having hurriedly jumped on the environmental bandwagon. Now manufacturers seeking to cash in on consumer concerns about the environment with spurious claims for their products may have to think again. A working party has been having discussions with several government bodies with a view to implementing a scheme that allows for products to be scientifically tested. If it goes ahead, the face of fake green marketing could be turning very red.

Compiled by **KERRIE HANNAN**, researcher with ABC-TV's Science Unit.



'In the US the latest development in the home building industry is the construction of houses made completely from recycled materials, including plastics, aluminium cans and old tyres.'



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QUANTUM LEAPS

AND PARADIGM SHIFTS

Robyn Williams

WE NEED MORE FOLKS LIKE THESE

I HOPE EVERYBODY now sees the point of a Commission for the Future. When we were conceived in 1986 (dad was Barry Jones, he hasn't said whether there was a mum), some folk ridiculed the idea. "The fewcha is what happens next. You don't commission it," they squawked.

In the 1990s we are chillingly aware of the nature of choice and, if we don't choose wisely, of the possible consequences. With traditional politics in Australia being so much a matter of sloshing about, we need at least one small reminder that there is next decade, next century, even next millenium to think of.

We are also, four years on, more thoughtful about the possible speed of change. I mean, imagine in 1986 trying to tell someone soberly that soon Germany would be united, Czechoslovakia free and Nelson Mandela socialising with the South African president. Just think then how quickly we could adapt to the new way of doing things that environmental and equity pressures require.

The Commission has had some conspicuous successes, but perhaps the most important have been less well known: putting Australians from all walks of life, but with similar predicaments, together. This was especially significant during the country's first discussions of the problems of the Greenhouse effect. We had farmers talking to scientists, engineers with lawyers, tourism operators with climatologists — and the synergy was stunning. All that energy, previously separate and slight, put together can take on almost anything.

Barry Jones is now free of ministerial office. This is an advantage. Mikhail Sergeyevich Gorbachev has asked for his counsel; at least one university has pondered the possibility of a chair; television and radio have offered countless invitations; some have already been accepted. Not a bad landing.

I'd find a ministry as welcome as a dose of the pox — always being pestered, no days or even hours for peace and quiet, endless compromise. Come to think of it, the pox might be better.

Barry Jones needs a larger, more flexible stage on which to entertain them — and us. He can be satisfied that he has helped put science on the national agenda and that his successor in the ministry, Simon Crean, will try to put it where it has been conspicuously absent on the trade union agenda.

I shall also miss Phillip Adams (my predecessor as Commission chairman). I don't think Australians recognise what an extraordinary mind he possesses. A friend of mine once said that Phillip has the most pungent command of words she's ever come across. Little wonder that he and Barry Jones are such great friends — what a combination. Here in Australia we may tend to have a rather cosy attitude to both of them as a pair of clever wombats, banging on about culture. It's delightful to have a good Oz down-to-earth approach, but it's at the risk of underestimating unique qualities. Phillip's leadership of the Commission was inspired, humane, and often hilarious.

Only two things made me cross. His smoking (we can't afford to lose him; besides, it's an odd habit for the man behind LIFE. BE IN IT) and his motor cars.

I know they're fun, but cars are really a preposterous way to get about. Consider, you have rank amateurs, millions of them, hurtling towards each other at impossible speeds, in conveyances as heavy as hippos. In Sydney it now costs \$150 a week just to keep one running — when was the last time you spent that much on taxis?

And they really are environmental villains. They produce 10 per cent of the Greenhouse gases (about 25 per cent of the carbon dioxide), kill or maim as many citizens as world wars and prevent more efficient means of public transport from being expanded. Did you know that 30 per cent of the petrol used in your car in a city like Melbourne or Sydney is burned going nowhere?

In London the average speed of the automobile about town increased from 11 mph to 13 mph between 1912 and 1985. Now it's actually going down. In Los Angeles they realise they cannot endure a city built for cars any more — cars are to be limited at last. The Angelinos may one day breathe properly again.

The head of Volvo International, Pehr Guillenhamer, has called for the end of cars in the centre of cities. He's being shrewd. If his company plans for alternatives, such as electric buses, light trains or hydrogen-driven vehicles, Volvo will be seven steps ahead of their rivals. It's good business.

Interestingly enough, I heard Hugh Mackay, the psychologist and business consultant, remark that, if we were told that our motoring is to be curtailed, most of us would feel a sense of relief.

Smoking (sorry Phillip) makes me just as cross. I am full of admiration for publishers like Ita Buttrose who refuse utterly to take cigarette ads. And, make no mistake, that courageous person would be so much better off if she were to drop her standards, and her concern for young women, and take the fag pushers' money and run adverts like all the rest. But she won't. Nor will Dick Smith. Nor will New Scientist magazine. Nor will 21•C.

Ita also has Vietnamese kids on the cover of her mag. She's willing to break all the rules to face a different and more exciting future for Australia. I wish this independent and forward-looking woman the very best with her ventures. She has given Australians both a symbol of someone with principles and of a female up there with the very best.

Most important, both she and Dick Smith, as well as Phillip Adams and Barry Jones for that matter, are lay-people who've all become thoroughly involved in scientific affairs. It's folks like these we'll need more of in future.

Cars are really a preposterous way to get about. Consider, you have rank amateurs, millions of them, hurtling towards each other at impossible speeds, in conveyances as heavy as hippos. In Sydney it now costs \$150 a week just to keep one running — when was the last time you spent that much on taxis?



ROBYN WILLIAMS is an ABC broadcaster and chairman of the Commission for the Future

SMART

Car makers have taken automobile design just about as far as it will go.

Traffic management is now the problem. To remain viable into the next

century, auto companies will have to turn their attention to traffic design.

PETER WHERRETT looks at future cars

Cars

CARS OF THE EARLY 21st Century will not be radically different from the cars we drive today. Their development will be evolutionary rather than revolutionary. They may look rather different, but they will have much the same feel and performance.

If there is a revolution in motoring ahead of us, it lies in the distinct possibility that the passenger cars of, say 2025, might not be "driven" by us — certainly not as we understand driving today.

Beyond about 2030 nobody knows, and most are not even prepared to speculate. The ascending graph of technological achievement suggests that anything is possible. Already there is a strong consensus of opinion that cars might still be around — but drivers will be long gone.

To a very large extent, the factors governing future automobile design have to do with density of traffic and traffic management. These have previously been considered neither a concern nor a function of car builders, but to sustain the viability of the passenger car well into the 21st Century, car makers will have to tackle the design of traffic systems. They will need to know what sorts of roads their cars might be using before they can design appropriate vehicles.

The end product of this kind of research and development is the intelligent car, networked into an intelligent road and traffic mix. The "smart car" of the future will need nothing more than an instruction from the operator to seek and find the destination in complete safety. Since the driver will then be relieved of the responsibility of driving and be free to pursue other occupations, private cars will be linked to home and office communications systems. We already have the car phone; it is only a matter of time before more sophisticated systems become standard features.

Electronics and computer management will certainly become commonplace: anti-locking brakes and auto-



THE MITSUBISHI HSR - 11

The HSR-11 concept vehicle represents the latest Japanese thinking on the development of an intelligent car. The advanced electronic control systems on board the HSR-11 enable all handling operations to be computer controlled. Signals from sensors around the car body feed into a microcomputer, backed up by a mother computer, which controls three systems:

- driving functions based on how the driver wishes to handle the vehicle, including vehicle suspension during cornering, braking or acceleration.
- a support function which is capable of taking over driving operations.
- a service function that presents visual display information to the driver, and adjusts on-board equipment to match the environment. An active aerobody controls airflow by changing the car's body shape.

The HSR-11 features four wheel drive, four wheel steering and four-wheel independent suspension. It has a plastic skin over a tubular frame structure. The advanced cybernetic control system of the HSR-11 can be likened to a living creature's nervous system. Like a cranial nervous system, the car's computers detect and analyse information, make optimum decisions, and control a "nerve network" which controls the execution of decisions.

GM IMPACT ELECTRIC CAR

General Motors, the world's largest carmaker, has announced it will produce the Impact, an aluminium skinned, electric-powered vehicle that accelerates to 100km/hr in eight seconds and has a top speed of 160km/hr. The Impact can travel up to 200km on a six-hour charge from a household power point. The car weighs 1000kg and has 32 ten-volt lead-acid batteries, similar to those in conventional cars.



matic sensing of wheel slip during acceleration are areas of more general application. Sensors will read wheel slippage and decrease the amount of drive being fed into that wheel, allowing the wheels with the best grip on the road to do the driving for the moment.

These developments in braking and acceleration, together with active suspension, are the beginning points for the eventual removal of many of the responsibilities of car operation from its human operator. This is the most exciting and radical direction motoring is taking — the development of smart cars on smart roads. Leading the field is a consortium of 14 European car makers which, in conjunction with over 50 scientific institutes, has established a project known as PROMETHEUS to look at a wide range of future possibilities.

PROMETHEUS is an anagram for program for a European Transport System with Highest Efficiency and Unprecedented Safety. To reach this objective, "all the available and forthcoming technologies in micro-electrics, communications, information technology, transport and vehicle technology must be systematically combined by the research partners to provide a co-ordinated all-round system," according to the PROMETHEUS manifesto.

The project is divided into five research departments. PRO CAR is to work on systems to provide the driver with better information on traffic flow and road and driving conditions. PRO NET is looking at methods for inter-vehicle communication. PRO ROAD seeks to develop systems for communications between vehicles and traffic infrastructure systems in order to provide choice of route to avoid jams, and even select the best refuelling points. PRO ART is dedicated to research in the field of information technology — such as signal, sign and symbol processing, and recognition of traffic patterns.

PRO CHIP will concern itself with on-board micro-

AERODYNAMIC DESIGN

Looking back at concept cars of the 1950s and 1960s, it is clear that the pursuit of aerodynamic efficiency has had the most lasting impact on car design.

Early attempts at an aerodynamic shape were mostly intuitive — designers did not have the benefit of extensive wind tunnel testing and computer modelling available today.

1 **ADVENTURER**: a prototype exhibited in the 1950s, the Adventurer was built by Ghia on a modified De Soto chassis. Its curvilinear form was said to be further evidence of the Italian influence over American construction.

2 **PROJECT X**: built by the Italian group Pininfarina, Project X caused a sensation among car designers in the 1960s. Conceived by Morelli, a lecturer in aerodynamics, its resistance coefficient was less than half that of saloon cars of the time.

3 **GM IMPACT**: first unveiled in 1990, this concept car is heavily influenced by aerodynamic principles.

4 **TOYOTA**: Japanese car design has been fast to adopt sleek, curved forms which minimise air drag, as in this Toyota concept car exhibited last year at the Tokyo motor show.



GOING GREEN BEYOND 2000

THE MOST significant issue determining the future of cars is the growth of "green consciousness". This developing concern for the environment is apparent in consumer choices, as well as in political discourse. The results will be both market pressure on car manufacturers to meet the changing wishes of consumers, and political pressure on governments to change, by regulation, patterns of behaviour which are seen to be wasteful and environmentally damaging. Such views are no longer the preserve of a wild-eyed minority of greens. The director of design for Ford Europe said recently, "Green is going to take over", and the former Chrysler director of exterior design is on record as saying, "The biggest single pressure on cars is the green issue."

The changes to the car which are likely to result from the greening of the world are quite dramatic. There will be fundamental changes to the way we view the social role of the car. Whereas the dominant mood of the 1970s and 1980s has been to shape all other needs to the dictates of the car, by 2020 it is quite likely that single occupancy of a motor vehicle will be regarded as irresponsibly anti-social behaviour. Most cars are now propelled by petroleum fuels: by 2020 air pollution from these fuels will almost certainly see them phased out.

The urban car still has a future, especially as so much of our urban design is clearly based on the assumption of car use. However, it is seen by some analysts as unacceptable to spend hundreds of millions of dollars on freeway systems to allow cars to be driven into the central business districts of our cities by nine-to-five workers. In the long term, the role of the car will probably be seen as filling the gaps which will still be left by an expanded public transport system.

As a result of this changing role, the urban car of the future is likely to be much smaller, lighter, more efficient, less powerful and less polluting. It will increasingly be seen as absurd to allow the use of cars with a top speed three to four times greater than the legal speed limit on most urban roads. The waste of resources involved in using tonnes of metal to carry a useful payload typically weighing about 70 kilograms will force the development of lighter vehicles which are more fuel-efficient.

Changing public attitudes will dictate the design of cars so that most of the materials can be recycled. More efficient transmission systems, such as the experimental continuously variable transmission, will contribute to improvements in fuel efficiency. Prototype vehicles being tested in Europe and Japan use about one-quarter the fuel of cars in use today.

In terms of the power source, it seems likely that we will move away from the petroleum fuels. The work being done on the use of metal hydrides as a storage medium for hydrogen is sufficiently promising to hold out hopes of this essentially clean fuel being in widespread use by 2020.

The other serious option is the increasing use of electric vehicles; most urban journeys are well within the range of current technology, and advances in battery design hold hopes of further extending the range of electric vehicles.

DR IAN LOWE,

Director of the Science Policy Research Centre, Griffith University, Queensland.

electronic systems, an example of which is known as Heading Control, which serves to stabilise the vehicle's direction of travel, making it virtually impossible to swerve out of control. A video camera determines the exact course of the road by "reading" road markings and feeding these signals into the vehicle's computer, which then analyses vehicle data and compares the results with the operating commands being generated by the driver. The computer will have the capacity to override the driver in order to provide the safest result.

As it is, most vehicles now rolling off the production line are equipped with trip computers, cruise control and digital vehicle information and warning systems.

FUTURE FUELS

BMW research into future fuels has concentrated on electric and hydrogen powered vehicles. Hydrogen produces practically no harmful pollutants (except for traces of nitric oxides when used with the source and electric power used as the source of pollution-free energy to the electricity generation facility). Inset: the engine of a BMW 735i, converted to run on a hydrogen shows few external differences. The engine can be switched to run on normal fuel as well.

Below: A prototype BMW Electric Car.



'I can foresee the day when I back my car into my suburban street, drive to the nearest main road and plug into the traffic system. I'll just dial in my destination and sit back'

Computers are becoming almost standard features. A "vision enhancer" is also being considered which could enable the driver to "see" through fog, sleet, rain or snow. Infra-red sensors detect the scene ahead and display their view directly on to the car's windscreen, effectively turning it into a large video screen. The concept is still in the process of research and development, but according to the

PROMETHEUS leaders, is not far from realisation.

The Japanese automotive industry is also looking at how to make driving simpler and less demanding. Intelligent electronic sensors are being developed to detect and report on road and traffic conditions and advise the driver, perhaps even monitor the driver's state of drowsiness, intoxication or poor information response.

Second generation computers are foreseen which will have a significant impact on automobile development and may even make possible human-like automobiles able to recognise patterns and make safety and other judgements. The Japanese are even considering how the sonar apparatus used by dolphins, bats and some birds to avoid collisions



might somehow be adapted to motor vehicles.

Australia is also playing its part in this field. A recent study conducted at Monash University on drowsiness and response time utilised an instrument to monitor the driver's blink rate and duration, triggering a warning device if the subject's eyes remained closed for more than half a second.

No automobile maker can ignore the question of future fuels, which in turn will dramatically influence future trends in pollution. Electricity, hydrogen and alcohol remain the most popular alternatives to the fossil fuels — petrol and diesel.

The problems of battery-powered automobiles have been battery weight, short range and relatively low speeds and acceleration. However new batteries, lightweight construction technologies and improved aerodynamics have led manufacturers to the view that electric-powered vehicles could be viable, particularly as town cars, within five to 10 years.

General Motors has recently released details of its Impact electric vehicle project. The Impact is powered by two AC induction-type motors, each driving one of the front wheels. Together they develop 114 horsepower at 6600 revs per minute and provide excellent acceleration capability and a top speed in excess of 100 kilometres per hour. The Impact is able to deliver power instantly, no matter how high or low the engine is revving, and has a range of nearly 200 kilometres, thanks to its aerodynamic shape, light weight, and motor and battery efficiency.

Its single gear ratio illustrates the electric motor's benefits over the internal combustion engine. Internal

VISION ENHANCER

Research into improving night vision has come up with a vision enhancer. Infra-red sensors detect the scene ahead and display the view directly on to the car's windscreen, effectively turning it into a large video screen.

friction is negligible, and at a steady highway speed of 100 kmh, the Impact consumes only one tenth of its peak power, with a tenfold increase available instantly.

Hydrogen fuel is another area of exploration by. The best way to store hydrogen gas as a fuel is as a super-cooled liquid, which requires a bulky, weighty container and very secure insulation against leakage, as hydrogen is dangerously flammable. But it does provide reasonable power and is very clean, with water vapour the only exhaust emission. Hydrogen, then, may be a suitable fuel for large cars and trucks where storage space is less of a problem. To produce adequate road performance, liquid hydrogen is pressurised before induction by means of a mechanical supercharger. Even then, output remains 30 per cent below that of petrol.

Mercedes Benz and BMW plan to increase the recyclable content of their cars from 75 per cent to 100 per cent. The "last service" for these fully recyclable cars would be to roll on to a "disassembly line", where robots would dismantle all parts and materials, and send them

space — a three cell structure — they will probably not look very different from the cars of today. But multifunctional vehicles are almost a certainty — vehicles which are adaptable for different functions and purposes by the owner/driver. They will be constructed from strong and lightweight hybrid materials, like the new plastics, kevlar and mylar, or new alloys of steel or aluminium.

Engines may soon be made of ceramics — initially for components, but later, perhaps for complete units. Engines with ceramic components are being developed and show considerable promise, especially in engine life. Ceramic engines offer better heat distribution and lower wear rates than metals. Archeologists dig up pottery that is thousands of years old — it is virtually indestructible.

There remain only a few specific areas in which new, even undiscovered technology can be applied. In the past decade the performance of small capacity internal combustion engines has been improved by higher than

SOLAR ELECTRIC TRAINS: THE WAY TO GO

THE POLES and wires are going up for electrification of Perth's decrepit rail system. The \$400 million investment, which includes a new rail service to Perth's auto-based northern suburbs, is the most significant transport event in decades for Perth.

Several letters to the newspaper have objected to the aesthetics of the poles and wires. To me they give a wonderful sense of pleasure and symbolise so much about the future transport system. The pleasure comes from being part of the battle to achieve the electrification decision. It is good to see the fruits of some intense work over a decade or so.

The symbol is far more important. The poles and wires say to me: here is the transport of the future — move over cars. Like most post-war cities, Perth has been built around the automobile. Now its freeways are full, its gasoline use is too high, its sprawl is too extensive, and the need for an alternative is increasingly obvious.

An electrified rail system will not only provide, for the first time in auto-oriented Perth, a transport system faster than cars, it will also link into the fuel supply system of the future — solar or renewable energy.

Electricity can be produced by solar, wind, biomass and any other renewable fuel, and because they are dispersed sources, they can feed into the central grid system from all over the place. Such a dispersed energy production system is already underway in California, where some 15,000 megawatts is produced outside of the big power stations from renewables, waste, etc.

We will be most unlikely to produce a solar fuel in liquid form that can be transported in individual vehicles; electricity will always be more attractive.

So we will have some electric cars (mostly for use outside of cities), but the far more efficient electric rail technology will become the basic city transport system. Light rail vehicles will be introduced into suburban areas, feeding into the main line and going at high speed to city centres.

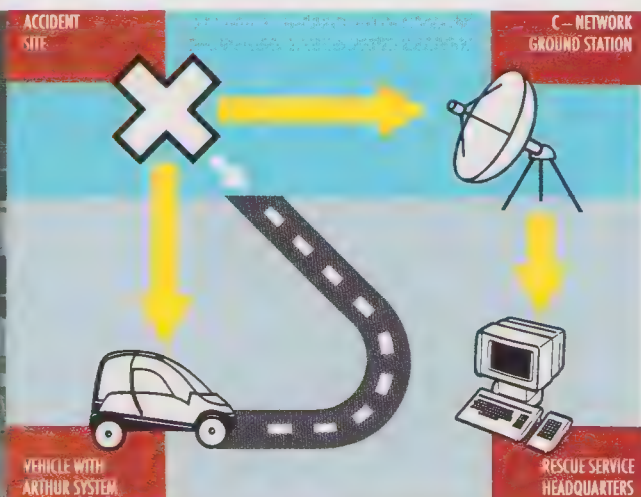
Local travel will be by bike and walking as a large number of destinations will be close at hand. This kind of city — more European than American — will have many other environmental, social and economic benefits.

The poles and wires going up along the rail lines of Perth could be there for several hundred years as fossil fuels phase out and renewables become the basis of our economy. They look pretty good to me.

DR PETER NEWMAN, Associate Professor in Environmental Science, Murdoch University, WA.



BENZ E-CITY CONCEPT CAR.



THE ARTHUR ELECTRONIC ACCIDENT ALERT SYSTEM.

off for re-use.

How will the cars of the future look? Before getting carried away with space age designs and gadgets galore, it is necessary to outline a few pertinent facts about automobile development and its future potential, at least for as long as roads remain much as they are:

- Cars cannot get faster — already there are strong arguments that they are too fast for today's roads. (There is no reason, however, why smart cars on smart roads shouldn't travel as fast as smart trains on smart tracks, and that is 300 kph plus.)

- Cars cannot accelerate more quickly — again there are road limits beyond which it is utterly unsafe.
- The limit of performance for brakes is rapidly being approached.
- The internal combustion gasoline engine is near its peak in terms of performance versus durability and fuel consumption.
- The handling and road-holding characteristics are near or at their practical limits, bearing in mind size, passenger comfort requirements and vehicle weight.

Most illustrations of future cars lean towards high performance sports machines — the inevitable prototypes, glamorous and full of promise. The reality is that if they require an engine, passenger space and luggage

THE E-CITY CONCEPT

The E-city transport concept developed by Daimler Benz is designed to minimise car accidents and dramatically reduce city pollution by eliminating car exhaust.

Small, electric-powered cars are linked to a "traffonics" system, a central computer which relays to individual vehicles traffic, weather and road data. The E-city car is designed specifically for local transport. It maximises energy efficiency with of light-weight hybrid materials, aerodynamic design, and compact size. Being electrically powered, there are no exhaust fumes to foul city air; however, there is still a pollution cost to be considered at the site of electricity generation.

Future development includes research into a system of self-guiding vehicles controlled by a central computer. This super-computer would program the speed and direction of all cars in order to optimise traffic flows and prevent accidents.

Further development of the technology of computer vision and artificial intelligence is required to make such an "automatic" driving system viable. But computer linked driving is on the way — as part of its "traffonics" research. Daimler Benz has already tested an emergency alert system for cars, called ARTHUR, which transmits a warning signal to a central computer in the event of an accident or a breakdown.

atmospheric pressure induction of fuel mixtures (turbocharging), multi-valves and more efficient combustion chamber design. As well, computers have accepted some responsibility for engine performance management (tuning).

The use of lightweight materials, plastics and aluminium has expanded, resulting in improved power-to-weight ratios. Suspensions have been stiffened to improve road holding and handling, resulting in firmer riding cars. There is now a move to electronically controlled suspension, known as "active

suspension"; which either allows the driver to select a suspension setting for a style of driving, or automatically adjusts to conditions and the manner in which the car is driven.

The car of the immediate future will see continued developments of these technologies, but there will be little change in the passenger car as we know it before the early part of the next century. After that, who knows? By then driving will probably be redundant. I can foresee the day when I back my car into my suburban street, drive to the nearest main road and plug into the traffic system. I'll just dial in my destination and sit back.

PETER WHERRETT is a motoring writer and broadcaster.

BEYOND 2030? The designs of Luigi Colani

THE IDEAL AERODYNAMIC FORM

As early as 1968 Italian designer, Luigi Colani, had designed what he believes to be the ideal aerodynamic form. The idea was to give the body's main cross section a shape representing the reversal of the wing of an airplane. This is based on the theory of converting the lift effect of a wing into a down force. An unfamiliar body configuration would result, however, when provision is made for passenger, engine and wheel space. Colani's basic aerodynamic car body shape is characterised by a smooth-bottom body which is suddenly turned up at the tail end. Both sides of the rear air flow outlet are walled in by the rear fenders which extend backwards. These views show the prototype of the "C form" which has been used as the base design for most of Colani's later car styles.



Future fun machine: Pontiac Stinger

CITROEN 2CV

The Citroen 2CV, by Luigi Colani — conceived in 1980, and recently tested in the Arizona desert. Born in Italy, but now working in Germany, Luigi Colani, is a maverick designer whose influence is increasingly being felt. Lauded by the Japanese as a genius, Colani believes that design should involve "imagination first, calculation second". Colani is heavily influenced by natural form, and takes as his starting point the

design of bodies with extremely efficient aerodynamic properties tested and refined in the wind tunnel. His imaginative transportation-related designs include aircraft, locomotives, monorails and ships. The new aerodynamics promoted by Colani presage a design ethic beyond contemporary form sense and technique, and making full use of the form — making flexibility of new materials, such as ultra-strong carbon fibre reinforced plastics.



GROWTH OF NICHE MARKET

Flexible car production systems being pioneered in Japan will enable economic exploitation of niche markets. Small production runs of individual designs are likely to grow along with the expansion of market and customer segmentation.

The Japanese ability to produce so many different models and variants puts them in a strong position for the 1990s.

1 The S-Cargo, which has gained almost cult status on Japanese roads

2 The Nissan Chappeau

3 The Figaro, one of the new 1950s retro models aimed at the Japanese market.



PONTIAC STINGER

General Motors has produced the ultimate youth market fun machine in the show model, Pontiac Stinger.

The Stinger is a prototype off-road vehicle, a kind of advanced beach buggy aimed at the youth market.

The car has a pneumatic suspension that allows it to be raised to improve ground clearance. It's a 3.0 litre, four cylinder engine rated at 170hp at 6,500rpm. This is mated to a three-speed automatic transmission which drives all four wheels.

All the seats in the car can be folded flat for sleeping on board. Seats are fully adjustable with bladders which can be inflated to change seating shape.

The Stinger has built-in storage for a list of items that reads like a camping guidebook — a pull-out radio, vacuum cleaner, camper stove, a hose, a torch, a picnic table, a tool box, a pair of binoculars, a first aid kit, a compass, magnifying glass, fire extinguisher and an umbrella, a mess kit, two small tool bags and a brush and dustpan.

The instrument panel has an attitude gyro which displays the vehicle angle and warns the driver if an angle steep enough to roll the car is being approached.



Pontiac Stinger: Details



MEMORY



Without memory we would be lost in a storm of unrelated instants. Yet medical science is only now beginning to understand this vital human capacity. And the findings are surprising — researchers have discovered a direct link between smell and memory. Computer scientists are interested, too. They are searching brain circuitry for clues to unimaginable computer power. ANDREW WATERWORTH takes us on a trip down memory lane

'And once I had recognised the taste of the crumb Madeleine soaked in her decoc-

tion of lime flowers which my aunt used to give me... immediately the old grey house upon the street, where her room was, rose up like the scenery of a theatre to attach itself to the little pavilion, opening on to the garden'

Marcel Proust, Remembrance of Things Past

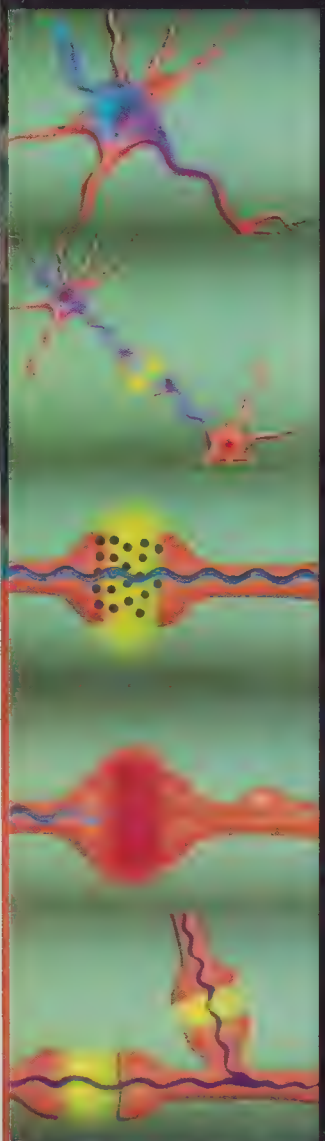
WHY SHOULD a scented crumb of cake be able to conjure up so potently an image from the past; more than an image, an entire scene? Writing at the turn of the Century, the French novelist Marcel Proust keenly observed a connection between memory and the sense of smell which scientists are only now beginning to understand.

That in itself is extraordinary, given that memory is the very cornerstone of our existence. Without the capacity

HOW NEURONS FORM MEMORY

A TYPICAL neuron is a cell body with a dual system of branches, one for receiving signals and one for sending them. Neurons communicate with each other via electrical impulses which are relayed from one to another across tiny gaps between the branch endings, called synapses. The impulses are carried across the gap by chemicals called neurotransmitters. Sometimes, something special happens: a change in voltage stimulates neurotransmitter activity sufficiently to allow unusually large amounts of calcium to flow from one nerve ending to another. This initiates an amazing chain reaction of biochemical events.

Calcium plays a vital role in the receiving nerve cell by activating an enzyme called calpain. The primary function of this enzyme is to break down certain proteins, allowing the structure and shape of the nerve cell to change. New cell branch endings are formed, increasing the number and therefore the strength of the synaptic connections, which has the effect of creating new circuitry between the neurons in the brain. This, scientists believe, is how memory is formed.



to learn and remember we are lost – we are no longer “ourselves”. But unlike a cornerstone, memory is located in more than one place.

Take, for example, the well-documented case from the early 1950s of a man with severe epilepsy. After medication had failed, doctors decided on the drastic measure of removing a small section of the brain which contained most of the hippocampus, the amygdala and some surrounding cortex.

The surgery was at least a partial success – the epileptic seizures became less severe. But there was an unexpected side-effect: the patient could no longer learn new facts. Introduced to his doctors each day, he would forget their names within minutes. More poignantly, he could not remember that one of his favourite uncles had died; each time he was told, he experienced the shock and grief anew.

Since that time, neurophysiologists have uncovered an increasingly complex network of functions in the brain that make up our memory. For a start, it appears we don't necessarily record a memory about a single object in one part of the brain. In the case of an apple, we might remember that it is red, sweet, crunchy, that it is a type of food, a fruit; but those bits of information are stored in different parts of the brain. This conclusion has come from research with patients suffering language disturbances. One patient who had experienced a stroke could point to an apple and describe it when the word “apple” was mentioned; but if presented with an apple and asked, “What is this?”, the patient was unable to say. He couldn't remember. Without the “password”, he was cut off from his own memory store.

So how is information stored in the human brain? It is a popular misconception that it is all done within individual brain cells or neurons. People often talk of losing their mental capabilities after excessive drinking in terms of loss of brain cells. But the physiology of the brain is far more complex and resilient.

Called by some the most complicated kilogram of matter in the universe, the human brain makes the most advanced supercomputer look like a primitive abacus. The number of neurons in the brain is in the order of a thousand million cells. Each of those cells is, in turn, connected to every other cell by about ten thousand connections.

The major breakthrough in recent years has come through an understanding of how our memories are formed and stored in the thousands of billions of connections between those brain cells.

At the Bonney Centre for the Neurobiology of Learning and Memory, University of California, Irvine, a team of researchers led by Dr James MacGaugh has discovered that

the biochemical sequence leading to memory formation is connected to the release of hormones in the body, especially when we experience strong emotions. If you think about it, this makes sense. The things you often remember most readily are events or occasions that caused you to become excited, frightened, passionate or nervous.

Dr MacGaugh cites the day of his marriage as one he remembers vividly. After 40 years he can still recall minute details, such as the future brother-in-law helping him adjust his bow tie and the smell of the sheet music. That's right, the smell.

Remember Marcel Proust and the lime-scented teacake? At the same university, Dr Michael Leon, Professor of

Psychobiology, has proved that there is a direct link between smell and memory. His research shows that smell is the single most important factor in determining memory during the first few days of life. Rather than the mother's voice or face, the first and most enduring memory a baby receives from its mother is her smell.

Leon began by looking at the physiology of rat brains. Baby rats were exposed to a particular scent or smell and stroked at the same time with a brush to simulate the mother's licking. Minutes later the rat pups responded to that same smell by crawling towards its source. When the researchers made images of the baby rats' brains, they found that in the case of those which had received the combined sensory stimulation, there was a 20 to 30 per cent increase in brain cell activity. This increased activity took place in the olfactory bulb, that part of

the brain dealing with smell.

According to Professor Leon, it appears that the act of smelling, or olfactory learning, produces a major physiological change in neurons in the brain of immature mice. It actually increases the number of neurons. This anatomical change during early olfactory learning appears to be the largest localised alteration following any kind of learning experience.

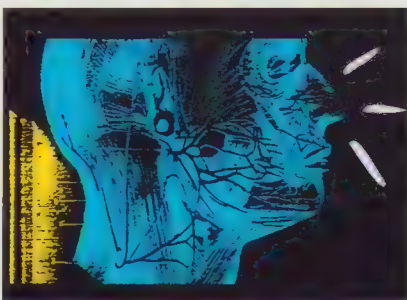
Professor Leon and his team decided to test the theory with human infants. At the University of California, Irvine, Medical Centre, they worked with babies who were just a few hours old. With their mothers' permission, the tiny infants were given a whiff of lemon scent while being lightly stroked for 10 minutes. The next day, when the babies were exposed to the lemon smell again, almost invariably they showed a preference by turning towards the smell. Already they had

formed a memory.

The fascinating assumption, based on the evidence from the baby rats, is that stimulating a baby's sense of smell during early infancy promotes the development of brain cell connections. Not only that, Leon also believes sensory stimulation may help save neurons that would otherwise die off.



'The most complicated kilogram of matter in the universe, the human brain, makes the most advanced supercomputer look like a primitive abacus'



This double boost to the baby's brain power means the significance of these findings is enormous. Dr Leon points out that medical scientists have long assumed that early experience puts its stamp on the brain and thereby changes the individual's response to the world. The new data indicate that these early experiences actually form various kinds of circuitries in different parts of their brains, which contribute to people being the individuals they are.

There is another unusual connection between the sense of smell and the way memory is recorded. When an animal orientates itself using smell, it sniffs at a particular frequency, between four and nine cycles per second. That rhythm is exactly the same as a brain wave pattern called the theta rhythm, which is especially characteristic of the hippocampus, a part of the brain crucial to forming memories.

A post-doctoral researcher working at the Bonney Centre has shown that the formation of new brain cell connections where memory is recorded is enhanced when the electrical impulses pass across the synapses at a certain frequency; the same frequency as the theta rhythm. The implication is that there could be an important link between the sampling rhythm of the sniffing and the way information is processed and learned, perhaps by activating the brain rhythm that is responsible for encoding the memory of smells.

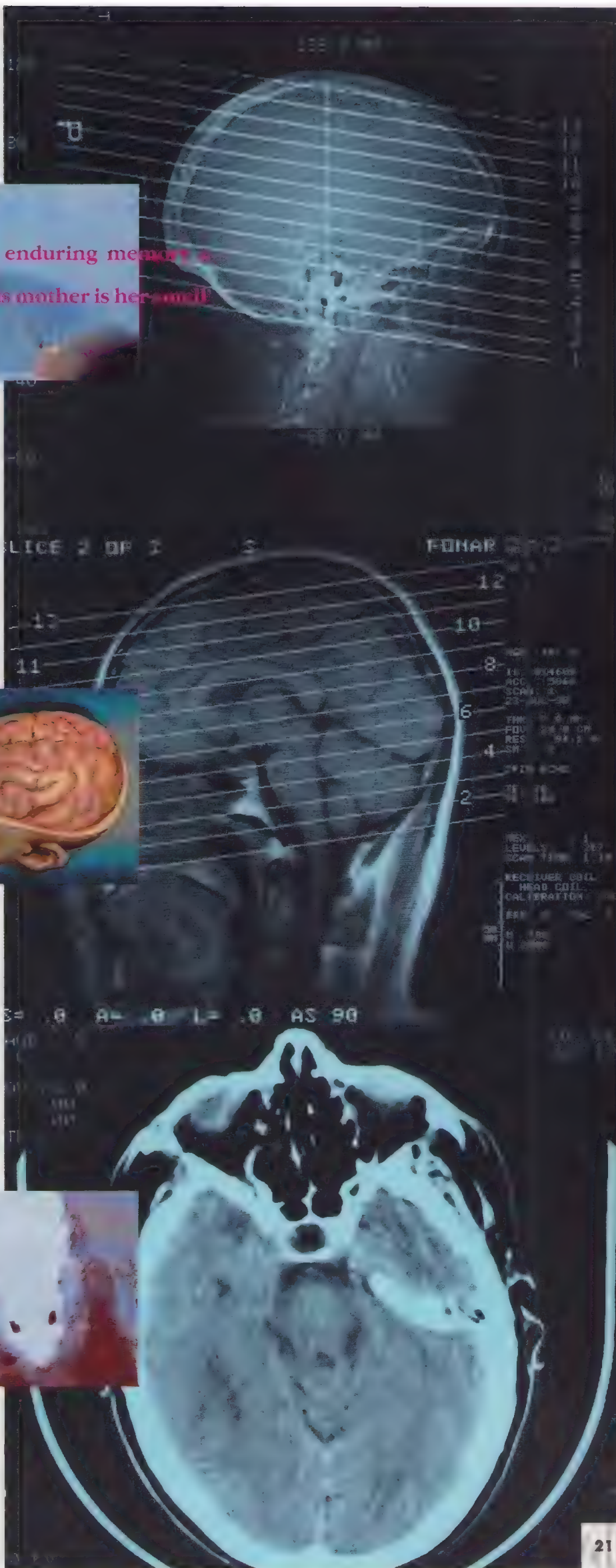
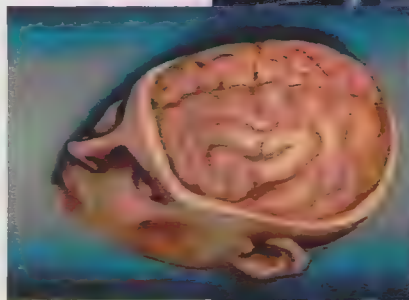
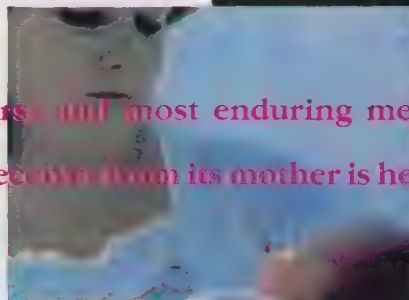
All this amounts to an increasingly detailed understanding of memory processes, from the biochemical molecular level right through to behaviour. Bonney Centre scientists have now developed a computer simulation based on the anatomy and physiology of the brain in the hope that it could provide them with a revolutionary design for the computer of the future, a computer that would perform tasks impossible for present-day digital computers.

In the future there may be help, too, for people who suffer memory loss due either to accidents or diseases such as Alzheimers. Dr MacGaugh's work showing the connection between hormonal stimulation and improved learning and memory indicates that it may be possible to develop drugs in 10 or 20 years' time which would improve patients' quality of life. The drugs wouldn't cure the disease or repair the damage, but they could assist in providing better memory recall.

MacGaugh sees memory as the bridge between the past and the present. So did Proust. The future may hold the promise of enhanced human memory and computers of unimaginable power.

ANDREW WATERWORTH is a reporter on ABC-TV's *Quantum* program.

'The first and most enduring memory a baby receives from its mother is her smell'





GREEN

The natural environment is treated as a free commodity. No one owns air, water and sunlight, so no one pays for environmental damage. But the debt must be paid; if not today then by future generations. LYUBA ZARSKY discusses a range of economic initiatives that would benefit both the planet and the balance sheet.



ECONOMICS

AS CONCERN FOR the environment becomes a mainstream issue, two modern and often contradictory intellectual traditions — economics and ecology — are beginning to fuse in new ways. In theory, economics and ecology need not collide. After all, they are linguistic cousins: both words find their origin in the Greek word *oikos*, meaning hearth or home.

In practice, economists and ecologists are often at loggerheads. One of the main problems is that economists view the natural world as limitless and costless. Economic models, decision-making rules and accounting frameworks simply exclude environmental costs such as pollution or depletion of resources. As a result, ecologists have viewed economic development as taking place at the expense of a finite natural environment.

The budding fusion of economics and ecology — what some have called “green economics” — is coming from two directions: the understanding that economics and ecology have common goal, and the emergence of policies that put the environment squarely into economic calculations.

A good economic manager, whether in business, government, or the home, follows two rules: the first is to avoid depleting the capital stock, and the second is to be efficient. The

first rule is also known as “don’t sell the family silver”. This rule suggests that productive assets should not be run down for short-run consumption or profit. It is better to add to today’s assets through investment, thereby increasing tomorrow’s gains.

Economists typically think of investment in terms of plant, equipment, infrastructure, and training and education or “human capital”. The natural environment, however, is the fundamental requirement of all our economic activity. Its ill-health impairs not only our physical health but our economic wealth, particularly in the long term.

It is useful to think of the environment as a stock of natural capital. Just as we cannot forever draw money out of a savings account without replenishing it, we cannot simply deplete the natural world without impairing its ability to keep on giving. Sound economic management would aim to live off the interest of our natural environment, rather than cutting into the capital.

The principle of non-depletion of natural capital stock — or no further environmental degradation — makes both economic and ecological sense. Land degradation in the form of salinity, acidifica-



SOURCE: HDM MATTINGLY [1990]

TO GROW OR NOT TO GROW?

THERE HAS emerged in the community a widespread concern about man's impact on the natural environment. Economists have long recognised these problems, and much of the recent sustainable development literature has its roots in economic studies undertaken in the late 1960s and early 1970s.

It is not true that economists regard the environment as a free resource. Economists have for decades studied the problems that arise when resources, including environmental resources, are not correctly valued. There exists a rich literature on the causes of environmental degradation and excessive rates of resource depletion, and on appropriate policies to correct for these instances where market forces are unable to generate socially desirable outcomes.

Many people are concerned that continued economic growth will result in global disaster because of continued depletion of resources from and outputs of waste to the environment. They assume the more rapid is economic growth, the more rapidly are resources depleted and the greater is the output of wastes. This does not necessarily follow, since it has proved possible, and will undoubtedly continue to be possible, to reduce both material required and waste produced per unit of output. However, the conservation movement has made a valuable contribution in reminding us that the natural environment cannot continue to be treated as a free good or it will suffer the usual fate of over-utilisation.

Continued economic growth is essential to the enhancement of world living standards. Without commitment to strong economic growth, we are sentencing most of the world's population to perpetual misery. The danger with the zero growth ideology is that it will divert attention from the economic, social and technological possibilities for improving the condition of man.

Unless zero growth policies were accompanied by a massive international redistribution of wealth, these policies would perpetuate the current extreme inequality in living standards. Moreover, nature does not provide our material requirements free.

Because many aspects of the environment have not been priced, an excessive rate of environmental depletion may have resulted. This needs to be corrected by policies designed to induce individuals to take into account the full costs of their actions.

Environmental resources must be correctly priced. Inherited problems need to be dealt with in an efficient, objective manner. The costs associated with the problem of Greenhouse gas emissions, for example, must be accurately measured before policies designed to reduce emissions are introduced. Reductions in emissions are costly and the costs need to be carefully balanced against the resulting benefits.

If not, it is possible that an excessive level of control will be imposed, reducing the ability of the world economy to finance the solutions to other problems, both of a material and non-material nature.

PETER CROWLEY
Economist, Australian Mining Industry

THESE SAVAGE TIMES

A LETTER arrived recently from the big woodchip company APPM, which is owned by North Broken Hill, letting me know they are going to log a 100-hectare block of forest behind my place. As far as I can tell, there has been no environmental assessment done. No one has stopped to ask if it's OK to kill the wildlife on the block, remove the nesting sites of dozens of creatures (I recently saw a white goshawk land in one of the oldest trees), or even if it would be wise

Continued next page

Continued from previous page

to study the block's plantlife, insects and Aboriginal sites before it is chainsawed, bulldozed and burnt.

What will happen to the forest? It will be carted off and turned into paper, and so most of it will end up in bins or rubbish tips. And that is in an island which has no paper recycling machines at all. Should we not say to APPM, as a starter: "No recycling, no more forests"?

We also have to challenge ourselves on such simple issues as: "Where does that paper tissue come from? What creature's nest did it destroy? Why not help the Earth by using handkerchiefs? Will this tissue be burnt, buried or found floating in the river?"

When the crunch comes, and the bulldozers move in on the block up the back, the challenge will be whether or not to break our money-based laws by getting in the way — to protect the natural laws which Chief Seattle spoke about in the US over a century ago. He said, "Whatever befalls the Earth befalls the sons of the Earth. Man did not weave the web of life: he is merely a strand in it. Whatever he does to the web, he does to himself. Where is the thicket? Gone. Where is the eagle? Gone. The end of living and the beginning of survival."

Chief Seattle was a true green economist in that he saw the whole. He saw the costs, beyond money, of our unreasonable demands on the Earth's finite resources.

He said, "I am a savage and I do not understand any other way."

The Earth needs a new breed of "savage" economists.

DR BOB BROWN
MHA, Tasmania.

HAWKE THE MARRIAGE MAKER

THE POLITICAL process in Australia will demand that economic considerations play a much more important role in the environment debate. Until now, there has largely been an ad hoc approach by the Federal Government to green issues.

That is a statement of fact, not necessarily a criticism. Government structures simply have not been able to keep pace with the growth of public interest in the environment. As a result, no consistent policy framework has existed.

The green debate is now set to become much more sophisticated. The Prime Minister has commissioned a discussion paper on definitions and targets for "sustainable development". It will be put to industry and the environment movement over coming months. At the same time, the Resource Assessment Commission is in place and has received its first references. The RAC will examine the costs and benefits of development and conservation proposals.

The Hawke Government also has created a new Cabinet mechanism to co-ordinate policy in relation to development and conservation — the Sustainable Development Sub-Committee. It is dominated by ministers with economic portfolios and consists of: Mr Hawke (chairman), Mr Keating, Senator Butron, Mr Beazley, Mr Kerin and Mrs Kelly (with Mr Crean and Mr Griffiths co-opted).

Quite clearly, the Government's objective is to integrate development and conservation. That process inevitably will involve close economic analysis of costs and benefits. The emotional appeal of green issues will be tempered by economic evaluation.

Just as resource industries have had to broaden their perspectives to take environmental values more into account, the onus now will be on the environment movement to become more economically literate. That will be a welcome advance in the green debate.

RICK FARLEY
Executive Director
National Farmers' Federation



tion, erosion and desertification, for example, is already reducing land productivity in Australia, Africa and elsewhere, cutting into farm income and food production. Further deple-

'Sound economic management would aim to live off the interest of our natural environment, rather than cutting into the capital'

tion of the ozone layer will cost billions of dollars as a result of increasing skin diseases and disruption to ocean eco-systems.

In a world of green economics, non-depletion of natural capital would form a basic constraint on all investment decisions. In selecting a project, technology, product or industry, economic managers would set the conservation of the natural environment as a baseline. From there, they would pursue their particular economic objectives, whether it be to maximise profits, sales, foreign exchange, employment or leisure.

The economic wisdom of not degrading the environment forms a conceptual grounding for the fusion of ecology and economics. The challenge is to develop ways of bringing this wisdom to all economic decisions, big and small. International

'The natural environment is the fundamental requirement of all our economic activity. Its ill-health impairs not only our physical health but our economic wealth'

negotiations to prevent further depletion of the ozone layer are a good example of the regulatory approach. Another is the notion of the "compensatory project". In any portfolio of proposed economic projects, environmental damage caused by one project, say a strip mine, would be compensated by environment-enhancing investment in another project, like reforestation.

The most innovative approach is to take the environment into account when designing projects and developing products. Environmentally friendly economic projects simply substitute for the environmentally degrading ones. In the Amazon rainforests, tribal people are developing export-oriented industries based on forest nuts, fruits and plants. In parts of Brazil, the value of such industries has already outstripped the value of logging and grazing.

In Australia, government and industry researchers are exploring the

market potential of "green industries" such as waste management, pollution abatement, environmental rehabilitation, recycling, and the domestic manufacture of high-efficiency energy products such as low-watt light bulbs and insulation materials. In West Germany, pollution control industries already employ over 100,000 people.

The second rule of sound economic management is that resources should be devoted to efficient projects, those that get the most out of what you put in. In economists' terms, efficiency means that individuals and society as a whole select economic projects which minimise waste of labour, energy and resources. Ecologists have no argument with economists in the pursuit of efficiency. Getting the most out of our productive processes could reduce what ecologists call "throughput" — the total amount of energy and resources which a society consumes as products and services.

An increase in energy efficiency, for example, releases investment funds that otherwise could have been tied up in funding for more power plants. It also means that everything made with energy inputs — that is, virtually everything in an industrial society — is cheaper. On the ecological side, it means that exhaustible fossil fuels like coal and oil are depleted less rapidly and that fewer Greenhouse-causing gases are emitted. The economy wins and so does the environment.

If environmental costs are excluded from market prices, as in the case of the depletion of the world's rainforests, economic efficiency will diverge from the ecologically wise path. In market economies, prices are determined primarily by market forces and secondarily by governments. Will markets, or governments, get the prices "right"?

When prices contain the right information, the least-cost economic strategy is also the ecologically wise one. The problem is that market prices, left to their own devices, simply exclude the costs of environmental damage. In economic terms, much of the natural environment — air, water, atmosphere, sunlight — is a "free" commodity. No one owns most of it, no one gets paid for its use, and no one individual pays the cost of its degradation. Environmental services like photosynthesis, protection from ultraviolet light by the ozone layer, the carbon-absorbing functions of ocean phytoplankton and rainforests, or just the beauty of

HOW GOVERNMENTS CAN HARNESS MARKET FORCES

Create markets

Governments can create markets where none presently exist. To provide an incentive to conserve water, for example, a government could establish property rights for a local council in a water catchment. The council could then sell water to other users.

The creation of markets requires that existing market prohibitions be eliminated. In most States in Australia, electricity can be supplied only by the State electricity commission. Other potentially cheaper and more efficient sources — like generating power with waste heat at the plant level — cannot sell excess electricity to the local electric grid system. Eliminating this restriction would encourage the development of a market in least-cost energy.

In the United States, energy efficiency markets are booming. Utilities buy electricity from cheaper suppliers and sell their own excess electricity to other utilities. Efficiency has become such a lucrative business that energy utilities in Southern California find that it is profitable to give away high-efficiency products like low-watt light bulbs and insulation to their residential customers. It costs the utilities much less to reduce energy demand and it also frees up excess electricity for sale to other customers.

Environment taxes

Taxes on pollution or resource depletion would make sure that the user pays environmental costs. For example, a carbon tax imposed on a barrel of oil or a tonne of coal would represent the cost of global warming resulting from the burning of fossil fuels. The tax would raise the cost of coal and oil, discouraging their use relative to cleaner sources of energy like natural gas, wind or solar power. It would also encourage companies to find alternatives to energy-intensive processes.

Several European countries have already embraced the concept of environmental taxes. In Italy and Sweden, shoppers pay a tax on plastic bags in supermarkets. Italy also has a tax on aircraft noise and the Italian Parliament is considering a further package of environment taxes. Heavily influenced by the Pearce report, Blueprint for a Green Economy, the UK is likely to embrace the economic incentive approach, including pollution taxes.

Some governments have used revenues generated by a resource depletion tax to support directly more efficient and renewable energy sources. In California, a "sustainables fund" financed by a tax on exhaustible resources was created in the late 1970s. By the late 1980s, it had helped to switch some 10 percent of California's electricity production from non-renewable to renewable sources such as wind and sunlight.

Marketable permits

The first step would be to put limits on pollution and resource depletion. Permits to pollute or deplete within those limits could then be sold to the highest bidder. Only permit-holders could engage in polluting or resource

depleting industries and, therefore, the permits would have a market value and could be sold. To prevent overfishing, for instance, the government could set a catch quota and sell the rights to it.

On the pollution side, tradeable permits provide an incentive for companies to control more of their emissions. They can either sell their surplus permits or use them to offset emissions in other areas of their business. When they are effective, marketable permits increase compliance rates at a lower enforcement cost than regulation.

Some economists are studying the feasibility of a global tradeable permit system for Greenhouse gas emissions like carbon dioxide. Administered by an international agency like the United Nations, the permits would be sold to the highest bidders. Since the rich countries are the biggest Greenhouse polluters, the funds generated could be used to help the poorer countries develop cleaner energy sources. The tradeable permits system could potentially sidestep the conflicts between rich and poor nations over how to reduce global emissions.

Deposit refund systems

Under a deposit refund system, consumers pay a surcharge when they purchase a potentially polluting product. The best-known example is a deposit paid on glass bottles. By providing an incentive to return what would otherwise be thrown away, the deposit refund system reduces litter and the flow of solid waste to landfills.

The system can extend to forms of hazardous waste which can be containerised, such as used motor vehicle oil, tyres and lead-acid batteries. Norway and Sweden already have successful deposit refund systems for car wrecks.

Eliminate unsound government subsidies

Government subsidies which promote inefficient and environmentally unsound development should be eliminated. In some States, the electricity commission is indirectly subsidised through its monopoly access to capital markets. In Victoria, for example, this subsidy skews the market toward the use of environmentally unfriendly brown coal and away from cleaner alternatives.

Support "green industry"

Besides eliminating subsidies for the environmental "baddies", governments could provide direct or indirect incentives for environmentally friendly industries. Providing start-up capital at or below market rates of interest could help stimulate green product innovation. Accelerating the depreciation of capital equipment could promote investment in newer, more efficient technologies. Directing research toward the greening of industry could promote the invention of new, efficient and clean products, services and technologies. Expanding product labelling requirements would help consumers choose environmentally friendly products.

a sunny day, come free of charge. Likewise, damage to the environment is a cost that is usually not borne by the particular individual doing the damage, but by the entire society — and future generations.

Since they are considered external to production, environmental costs are not calculated when setting market prices. Producers and consumers have no economic incentive to minimise environmental costs. The solution is for governments to shape the economic terrain in a way that puts the environment into market equations. In the language of economics, governments should help markets to internalise environmental costs.

The main way governments in Australia have tried to incorporate the environment into the economy is through regulation. Putting limits on emissions of water or air pollution, setting aside land to preserve habitats, requiring environmental impact assessments and developing industry-level guidelines are all examples of the regulatory approach. Its weakness is that it can be expensive to enforce.

A new approach is emerging. Called the "market-based incentives" approach, it aims to provide economic incentives to producers and consumers to choose more environmentally friendly products, processes and practices. This is done by ensuring that prices reflect true costs — not just direct costs, but also environmental and social costs. The economic incentive approach aims directly to integrate economics and ecology by utilising market forces to protect the environment (see box).

The integration of economics and ecology is still evolving. At the policy level, it is still in its infancy, though the growing political power of the green movement may give it a big growth spurt in coming years.

The long-term objective is the creation of a green industrial or post-industrial economy. A green economy requires an economic infrastructure which tilts all economic decisions toward protecting the environment. Both regulation and market-based incentives play a role in generating such an infrastructure. The appropriate mix depends on the environmental and economic problems at hand.

Treating the environment as the fundamental requirement for economic development is the starting point. From there, the tools and insights of economics could be used to protect rather than to ravage the environment.

CONFUSING, ISN'T IT?

IT MIGHT come as a surprise to learn that the science of economics has a long history of being "green". For example, some of the first warnings about soil erosion, over-exploitation of fisheries, and the cost of pollution came from economists.

What can confuse most people is that the principles that apply to many business decisions, to government policy-making, and to much consumer behaviour, are not based on economic concepts, but on financial considerations — and the two can differ dramatically. Take another matter which causes confusion — the traditional measure of economic wellbeing, gross national product. No economist suggests that, in its present form, it measures real economic progress or decline.

It adds in the cost of pollution as an increase rather than a decrease in growth. It does not take into account depreciation of natural capital (soils, forests, mangroves, etc), while it does take into account the depreciation of machines and factories. It does not take into account the quality of life; for example, increased leisure time.

A final misunderstanding of economics is that some people who become involved in environmental issues — some ecologists, for example — believe that economists are applying their personal values in their analyses.

Based on this misplaced understanding, environmental scientists are likely to argue that their value judgements and policy prescriptions are better founded than those of the economists. The problem here is that it is not understood that economists' analyses are based on the preferences and dollar values of everyone out there — consumers and producers.

Confusion and misunderstanding aside, the practitioners of the "dismal science" — as economics is known — need the ecologists and other environmental scientists, and vice versa. The world cannot be sustained without the combined knowledge and efforts of both groups.

DR TOR HUNDLOE

Director, Division of Australian Environmental Studies Institute of Applied Environmental Research, Griffith University, Queensland. Commissioner, Industry Commission.

BE WILLING TO CHANGE THE RECIPE

IT IS NOT a simple task to manage complex systems like the economy or the environment, yet we must do both in a consistent manner. Because of the complexity it is not useful to rely on using rigid recipes. A more promising approach is to apply some general principles which can help map out the way ahead for Australia; principles that can be applied to foster economic development that is ecologically sustainable. The key principles to bear in mind are:

- Identifying the environmental problem
- Setting clear goals
- Conveying a range of feasible options
- Identifying costs and negative impacts, as well as benefits
- Considering side effects
- Directly addressing problems
- Allowing for flexibility
- Ensuring inbuilt incentives for industry
- Using of broad-based revenue-raising measures to be consistent with tax policy objectives
- A presumption against using subsidies or general tax concessions
- Ensuring the application of the "polluter pays" principle.

PETER BIGGS

Acting assistant secretary, Primary Industries, Trade and Environment Branch, Federal Department of Treasury.

EXTINCTION

The roll call of extinct Australian wildlife is one of the longest in the world. Since Europeans arrived in 1788, 18 species of mammals, 10 birds, and about 100 species of plants have become extinct. They are lost forever.

It is easy to blame the early settlers for the decline and disappearance of many species, but they were people struggling to survive in this strange new land, and few understood the importance of keeping the often precarious balance of nature.

Today we know better. Without the variety of species we share this planet with, Earth might not be habitable by humankind. The danger to our native wildlife has never been more severe. Now facing extinction within 10 to 20 years are: • 41 mammals, • 18 birds, reptiles, fish and frogs,



• more than 200 invertebrates, and • 209 plants.

Plants and animals have become extinct before—the extinct giant wombats and kangaroos are examples. The process is usually slow, taking thousands of years and longer, which allows sufficient time for other life forms to adjust to the change. But so many plants and animals becoming extinct or endangered in such a short time is a sign of an unbalanced, unhealthy environment.

In this comprehensive coverage, 21•C presents a guide to those Australian mammals either extinct or facing extinction. The tally of 59 from a total number of 262 at the time of European settlement is sobering. We have used the official Concom list, augmented with those mammals considered by the World Wildlife Fund for Nature to be in immediate danger of extinction.

IS FOREVER



P. Woolley, D. Walsh



National Photographic Index



Bubs and Bert Walls



H. & J. Beste

1 LONG-TAILED DUNNART or YARRUTJU

Sminthopsis longicaudata

Range: Gibson Desert and east Pilbara, WA, possibly also in central Australia. Habitat: rugged slopes and plateaux of desert ranges.

Threats: Unknown. Three populations are now known from widely separated localities in the Gibson Desert and Aborigines report that it is widespread in this region.

2 SANDHILL DUNNART

Sminthopsis psammophila

Range: formerly known only from near Lake Amadeus, NT, and the Eyre Peninsula, SA. Now known only from Eyre Peninsula.

Habitat: sand dunes and plains with mallee and shrubs over ephemeral; or spinifex grasses.

Threats: habitat destruction, introduced predators.

3 JULIA CREEK DUNNART

Sminthopsis douglasi

Range: known from only four specimens collected at Julia Creek in Queensland between 1931 and 1972. Habitat: not known, but the specimens were collected from a region which contains grasslands and savannah woodlands.

Threats: unknown.

4 NUMBAT OR WALPURTI

Myrmecobius fasciatus

Range: formerly widespread in southern Australia. Now restricted to a few small populations in the south-west of WA.

Habitat: forests, woodlands and shrublands. Shelter in hollow logs, tree trunks and burrows.

Threats: introduced predators, unsuitable fire regimes.

5 WESTERN BARRED BANDICOOT OR NYEMMEL

Perameles bougainville

Range: formerly from the Pilbara to western NSW. Now presumed extinct on the mainland; last recorded in 1922. Remains only on Bernier and Dorre Islands Nature Reserves, Shark Bay, WA.

Habitat: dense scrub, bluebrush and saltbush plains. Widespread on Bernier and Dorre Islands in shrublands and grasslands.

Threats: introduction of predators, unsuitable fire regimes.

6 GREATER BILBY, DALGYTE OR NIRNU

Macrotis lagotis

Range: formerly widespread south of the moist tropics and west of the Great Dividing Range. Now rare and scattered.

Habitat: wide variety of sandy, loamy or stony country with woodlands, shrublands or grasslands; lives in a burrow.

Threats: unknown; unsuitable fire regimes, competition with rabbits and predation by foxes have been suggested as the reasons for its decline.

7 LEADBEATER'S POSSUM

Gymnobelideus leadbeateri

Range: south-eastern Victoria.

Habitat: montane forest at altitudes of 500-1500m. Inhabits mature forest; only lives in regenerating forest if some old nest trees remain.

Threats: habitat destruction.

8 NORTHERN HAIRY-NOSED WOMBAT

Lasiorhinus krefftii

Range: formerly found in southern NSW, in southern Queensland and in an area 130km north-west of Clermont in Queensland. Now very rare; only a single small colony remains at Clermont.

Habitat: occupies burrows in semi-arid mixed eucalyptus/acacia woodland.

Threats: previously habitat degradation, predation by dingoes, competition with cattle, sheep and rabbits.

9 LONG-FOOTED POTOROO

Potorous longipes

Range: eastern Gippsland, Victoria.

Habitat: open forest of eucalyptus and shrubs and a dense cover of wiregrass, ferns and sedges growing on friable, clay soils.

Threats: commercial forestry.

10 BRUSH-TAILED BETTONG OR WOYLIE

Bettongia penicillata

Range: formerly widespread across southern Australia. Now restricted to remnant populations in south-west WA including Tuttanning Nature Reserve and Dryandra and Perup State Forests. Re-introduction program underway to St Francis Island, Isles of St Francis Conservation Park, SA.

Habitat: dry sclerophyll open forest or woodland with a shrub or tussock grass understorey. Builds a grass-lined nest in dense vegetation, under a fallen shrub or occasionally in a hollow log.

Threats: habitat destruction, unsuitable fire regimes, fox predation.



Babs and Bert Wells



J. Lachman



A. Smith



C. Andrew Henley



World Wide Fund for Nature



Babs and Bert Wells





Babs and Bert Wells

Babs and Bert Wells



G. Robertson

H. & J. Beste



J. & D. Bartlett

R. Whitford

11 BURROWING BETTONG or BOODIE

Bettongia lesueur

Range: formerly widespread in arid and semi-arid Australia west of the Great Dividing Range and south of the tropical savannah. Presumed extinct on the mainland; now restricted to Barrow, Boodie, Bernier and Dorre Islands, WA. Habitat: inhabited a wide variety of country; lives in burrows, often congregated into extensive warrens. Threats: introduction of predators.

12 RUFOUS HARE-WALLABY or MALA

Lagorchestes hirsutus

Range: formerly widespread through much of arid and semi-arid Australia. Very rare on mainland; only two small populations remain in the Tanami Desert, NT. Good populations on Bernier and Dorre Islands Nature Reserves, Shark Bay, WA. Habitat: spinifex grasslands of the interior, low heath or shrublands in the south-west and on islands. Digs a short burrow in summer, lives inside spinifex hummocks or under low shrubs in cooler months. Threats: extensive fires, introduced predators.

13 BANDED HARE-WALLABY or MUNNING

Lagostrophus fasciatus

Range: formerly occurred in semi-arid south-west of WA. Presumed extinct on mainland, and on Dirk Hartog Island. Last recorded on mainland in 1906. Good populations on Bernier and Dorre Islands Nature Reserves, Shark Bay, WA. Reintroduction program to Dirk Hartog Island commenced in 1974. Habitat: sclerophyll woodlands and shrublands. During the day it shelters under thick shrubs. Threats: introduced predators, unsuitable fire regimes.

14 BRIDLED NAILTAIL WALLABY or MERRIN

Onychogalea fraenata

Range: formerly in non-coastal eastern Australia; now very rare; a single population is known from a small area in eastern Queensland, north-east of Dingo. Most habitat now a nature reserve. Habitat: woodland and tall shrubland dominated by brigalow, eucalyptus woodland and grass. Threats: dingo predation; previously competition with introduced herbivores and habitat destruction.

15 PROSERPINE ROCK-WALLABY

Petrogale persephone

Range: recently discovered in the Proserpine district, north-eastern Queensland. Habitat: rocky outcrops in closed forest. Threats: at risk because of its very small range; competition with other Petrogale species possible.

16 NORTHERN BETTONG

Bettongia tropica

Range: highly restricted to a small area on the western edge of the North Queensland Wet Tropics World Heritage area. Habitat: rainforest. Threats: such a small and localised population is vulnerable to both natural and human threats.

17 MOUNTAIN PYGMY-POSSUM

Burramys parvus

Range: restricted to alpine and sub-alpine regions in Victorian and NSW. First recorded in 1966 at Mt Hotham, Victoria. There are at least four small sub-populations at Mount Kosciuszko, Mt Bogong, Bogong High Plains and Mounts Lock and Higginbotham. Habitat: high altitude low scrubs and grasses. Threats: ski fields development, possibly the Greenhouse effect.



18 ATHERTON ANTECHINUS

(Antechinus godmani)

Range: restricted to an area of approximately 600 square kilometres of dense rainforest above 600m between Cardwell and Innisfail in north Queensland. Habitat: unusual foraging behaviour, hunting on the forest floor, the tree buttress and stem, and even in the high rainforest canopy. Threats: cane toad invasions that follow logging activities.



19 KOWARI

Dasyuroides byrnei

Range: formerly the central Australian arid zones. Now restricted to desert regions in south-western Queensland. Habitat: sparsely vegetated gibber desert. Threats: habitat destruction through grazing, and predation by red foxes.

G. B. Baker



20 CHUDITCH OR WESTERN QUOLL

Dasyurus geoffroii

Range: formerly across the southern two-thirds of the continent; now restricted to south-western WA. Habitat: the remaining stands of jarrah forest. Threats: changing fire regimes and introduced predators, particularly in the arid zones. In the south-west of WA, habitat loss and exotic predators.



21 MULGARA

Dasyercus cristicauda

Range: formerly widespread throughout the central Australian arid regions; now only in NT and possibly WA. Habitat: in burrows on the flats between sand dunes or the slopes of high dunes. Threats: unknown.

22 DIBBLER

Parantechinus apicalis

Range: formerly covered most of south-west WA. Unsighted for 83 years, before being rediscovered in 1967 near Cheyne Beach in south-west WA. Since then four other populations have been discovered at Fitzgerald River National Park, Torndirrup National Park and on Boullanger Island and Whitlock Island, WA. Habitat: dense coastal heaths. Threats: formerly land clearing, introduced predators and inappropriate fire regimes. Now, development of its coastal habitat.

R. & A. Williams



P. Woolley/D. Walsh

T. Soderquist

R. Whitford

Beds and Bert Wells



23 RED-TAILED PHASCOGALE

Phascogale calura

Range: south-western WA. Formerly patchily distributed throughout southern and central Australia.

Habitat: wandoo and rock oak forest communities.

Threats: clearing of native forests and predation by cats and foxes.

24 GOLDEN BANDICOOT

Isodon auratus

Range: formerly throughout the arid and semi-arid regions of central, northern and north-western Australia. Now reduced on the mainland to a small area of the north-west Kimberleys and also found on Barrow, Middle and Augustus Islands, WA.

Habitat: spinifex and tussock grasslands.

Threats: formerly competition from rabbits, predation by foxes and cats, and changed fire regimes in the deserts since Aborigines were coaxed on to missionary settlements.

25 EASTERN BARRED BANDICOOT

Perameles gunnii

Range: still relatively common in Tasmania, but highly endangered on the mainland; now restricted to only a fragment of its former range, centred at Hamilton in south-west Victoria.

Habitat: suburban gardens in Hamilton, nearby grasslands and a car dump site. A new captive colony has been established at Gellibrand in Victoria.

Threats: destruction of its preferred grassland habitat and killing by introduced predators.

26 WESTERN RING-TAIL POSSUM

Pseudocheirus occidentalis

Range: although the ringtail is widely distributed around the country, the Western Australian subspecies is considered endangered.

Threats: predation by foxes, inappropriate fire regimes, and the continued fragmentation of its forest habitats through agricultural expansion.

Habitat: peppermint gums, paperbark forests and eucalypt woodlands.

27 CENTRAL AUSTRALIAN BRUSHTAIL POSSUM

Trichosurus vulpecula

Range: often thought of as a pest in the suburbs of cities in eastern States, the species is in trouble in central Australia where only six animals have been observed in recent years.

Habitat: along watercourses and in sheltered gullies.

Threats: a rapid decline of unknown cause took place in the 1930s.

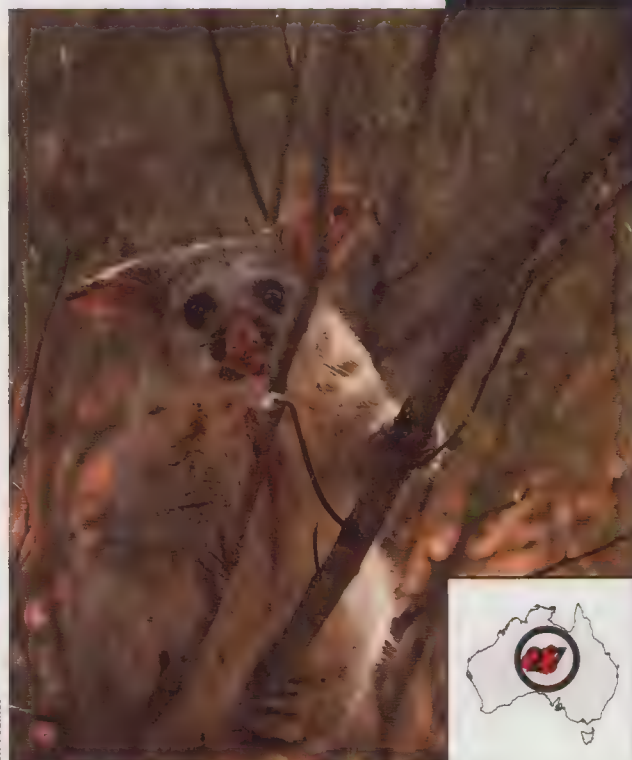
28 FALSE WATER-RAT

Xeromys myoides

Range: coastal Queensland and NT; few widely scattered populations known.

Habitat: coastal swamps and mangrove forests.

Threats: habitat destruction.



29 GREATER STICK-NEST RAT

Leporillus conditor

Range: formerly in arid and semi-arid country in southern Australia. Presumed extinct on mainland; last recorded in 1922. A secure population remains on Franklins Island, Nuyts Archipelago Conservation Park, SA.

Habitat: shrublands. Constructs a nest from sticks and stones in caves or crevices and among shrubs.

Threats: introduced animals, unsuitable fire regimes.

30 CENTRAL ROCK-RAT

Zyzomys pedunculatus

Range: southern NT; few populations known; last recorded in 1960. Possibly extinct.

Habitat: rock outcrops and ranges.

Threats: unknown; probably vulnerable to introduced predators.

31 SHARK BAY MOUSE

Pseudomys praeconis

Range: formerly known from Peron Peninsula and Bernier Island, Shark Bay, WA. Presumed extinct on mainland; last recorded in 1858. Secure population on Bernier Island Nature Reserve.

Habitat: coastal dunes with beach spinifex, shrubs and annuals.

Threats: introduction of predators, unsuitable fire regimes.

32 DUSKY HOPPING-MOUSE

Notomys fuscus

Range: formerly central and northern SA, south-west Queensland, Nullarbor Plain, SA and WA. Recently recorded only from north-eastern SA and south-west Queensland.

Habitat: sand dunes.

Threats: unknown.

33 NORTHERN HOPPING-MOUSE

Notomys aquilo

Range: Cape York, Queensland and coastal Arnhem Land, including Groote Eylandt, NT. Recently collected only from Groote Eylandt and northern Arnhem Land, NT.

Habitat: partially stabilised coastal dunes with acacia scrub and an understorey of spinifex hummocks.

Threats: habitat destruction or degradation.

34 SMOKY MOUSE

Pseudomys fumeus

Range: formerly in south-east NSW, and more extensively throughout eastern Victoria; now confined to the Grampians, Victoria, and the coastal woodlands of east Gippsland.

Habitat: heathlands and dry forests. Relies on seeds of shrubby legumes, berries and Bogong moths in summer, and a winter survival strategy that includes eating underground fungi.

Threats: habitat destruction.



A. C. Robinson



A.N.P. & W.S.



Babs and Bert Wells



H. & J. Bestie

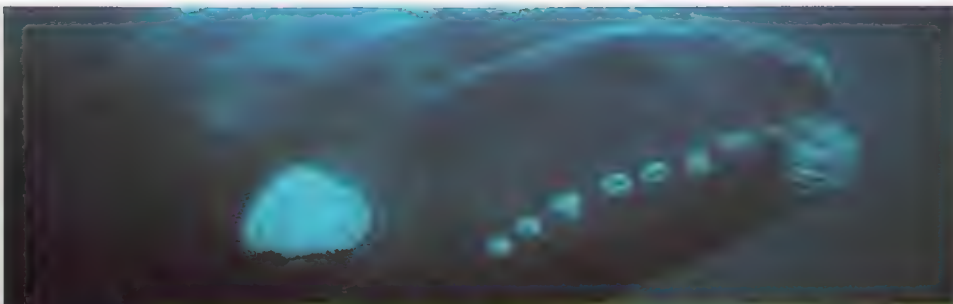


Donald Thomson



G. B. Baker





Jean-Paul Ferrero

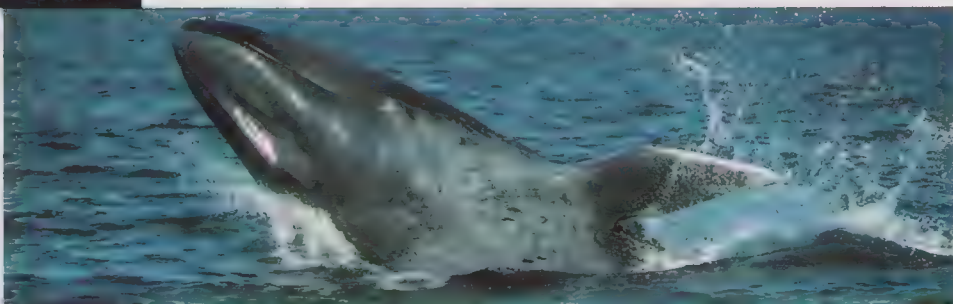
35 SOUTHERN RIGHT WHALE

Eubalaena australis

Range: mainly in sub-Antarctic waters in summer; migrates north to breed in continental waters in winter. Drastically depleted by over-exploitation prior to protection in the 1930s; world-wide population is less than 2000.

Habitat: oceanic; breeds in shallow bays south of 30°S.

Threats: illegal hunting; vulnerable to human interference in shallow waters — shipping, pollution and entanglement in fishing gear.



François Gohier

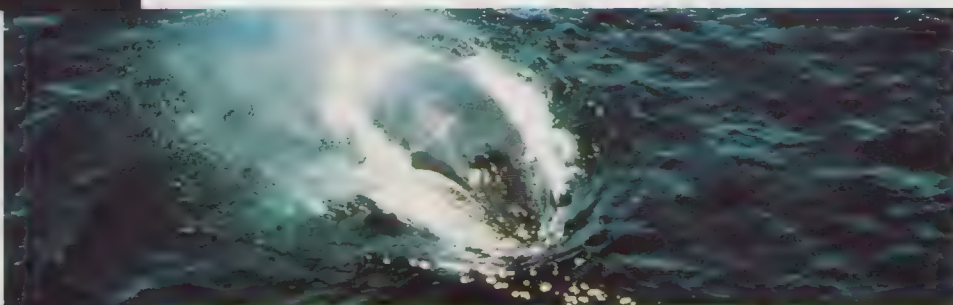
36 BLUE WHALE

Balaenoptera musculus

Range: all major oceans. Severely depleted by over-exploitation by the whaling industry. Although protected by the International Whaling Commission in 1965, there is no clear evidence that populations are increasing.

Habitat: open ocean.

Threats: illegal hunting; exploitation of food species, especially the Antarctic krill.



D. J. James

37 HUMPBACK WHALE

Megaptera novaeangliae

Range: oceans from Arctic to Antarctic. Drastically reduced by over-exploitation prior to protection by the International Whaling Commission in 1965. Surveys suggest the numbers migrating along Australian shores is increasing.

Habitat: oceanic; often in shallow coastal waters.

Threats: illegal hunting; vulnerable to shipping, pollution and entanglement in fishing gear; exploitation of food species, especially Antarctic krill.



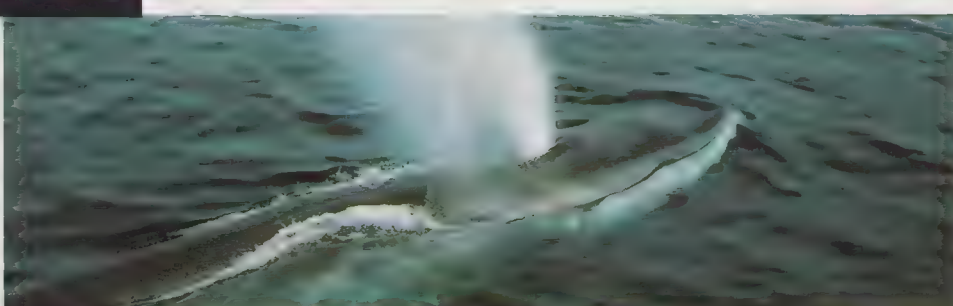
D. J. James

38 SEI WHALE

Balaenoptera borealis

Range: widely distributed in all oceans. Habitat: generally avoids areas close to the ice. The pair bond seems to be important and they are believed by some to be monogamous.

Threats: numbers seriously reduced by hunting and the species finally had to be protected. New estimates for large whales in the Antarctic put their numbers at 1500.



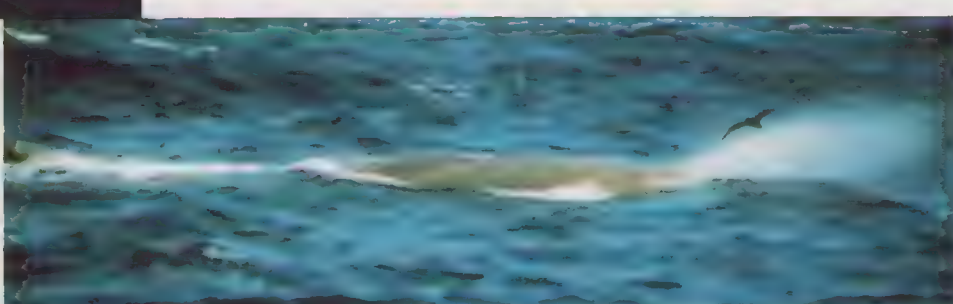
François Gohier

39 FIN WHALE

Balaenoptera physalus

Range: all oceans; tend to avoid icepacks. Habitat: migrate towards the equator in winter.

Threats: stocks have been decimated by commercial whaling. From an estimated 448,000, their numbers were reduced to 70,000-80,000. Recent estimates give cause for alarm as they put the size of the Antarctic population at 2,096.



P. J. Mannell

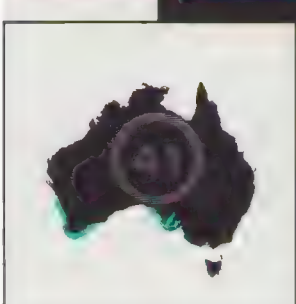
40 SPERM WHALE

Physeter macrocephalus

Range: all Australian waters.

Habitat: spend most of their lives in warm seas between 40 degrees N and 40 degrees S; favour the edges of ocean trenches.

Threats: populations around Australia were decimated by commercial whaling. Recent estimates put their numbers in the Antarctic at just 3,060, from a worldwide population once estimated at more than one million.



C. Andrew Hanley

41 AUSTRALIAN SEA LION

Neophoca cinerea

Range: extends from Kangaroo Island in SA to Houtman Abrolhos Islands off the coast of WA.

Habitat: inshore waters, colonising sandy beaches on rocky shores. Threats: total population numbers between 3,500 and 5,000 and possibly declining. Heavily hunted last century. Their breeding sites are sensitive to human disturbance.

1 THYLACINE or TASMANIAN TIGER

Thylacinus cynocephalus
The last captive animal died in 1936. There have been numerous unsubstantiated sightings since.
Range: throughout mainland Australia until 2000-3000 years ago when it died out due to competition with the dingo. Survived in Tasmania where there were no dingos.
Habitat: savannah woodland or open sclerophyll forest with rocky outcrops.

2 DESERT BANDICOOT or WALYILYA

Perameles eremiana
Last recorded in 1931.
Range: formerly widespread in the deserts of WA, NT and SA.
Habitat: spinifex grasslands.

3 LESSER BILBY or YALLARA

Macrotis leucura
Last recorded in 1931.
Range: formerly in Lake Eyre Basin and Simpson Desert.
Habitat: desert spinifex grasslands; lived in a burrow built in sandhills.

4 PIG-FOOTED BANDICOOT

Chaeropus ecaudatus
Last recorded in 1907.
Range: formerly widespread in the interior from the Murray-Darling River junction to Alice Springs and the south-west of WA.
Habitat: woodlands, shrublands, grasslands.

5 BROAD-FACED POTOROO

Potorous platypus
Last recorded about 1875.
Range: formerly in south-west WA; known only from Goomalling, Albany and the Pallinup River.
Habitat: woodlands and shrublands.

6 DESERT RAT-KANGAROO or ULAKUNDA

Caloprymnus campestris
Last recorded in 1935.
Range: formerly recorded from a small area in north-east SA and south-west Queensland.
Habitat: sparse shrubland on gibber plains and dunes. Built a nest from leaves and grass under a small shrub.

7 EASTERN HARE-WALLABY

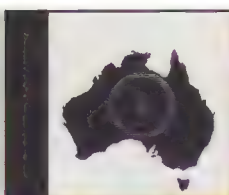
Lagorchestes leporides
Last recorded about 1890.
Range: formerly occurred in inland NSW, eastern SA and north-west Victoria.
Habitat: grassy plains.

8 CENTRAL HARE-WALLABY

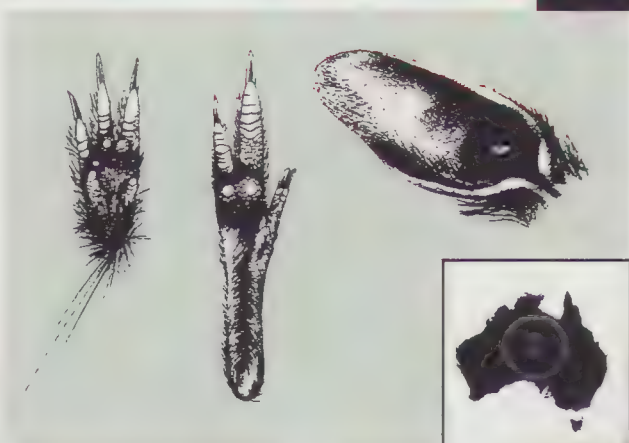
Lagorchestes asomatus
Only known from a skull collected in 1932 from a site between Mt Farewell and Lake Mackay, NT.
Habitat: unknown.

9 CRESCENT NAIL-TAIL WALLABY or TJAWALPA

Onychogalea lunata
Last recorded in 1930.
Range: formerly from south-west WA through central and eastern WA to Alice Springs.
Habitat: thickets in eucalyptus woodlands and mulga woodlands.



R. H. Green



Royal Society of Victoria



Thomas



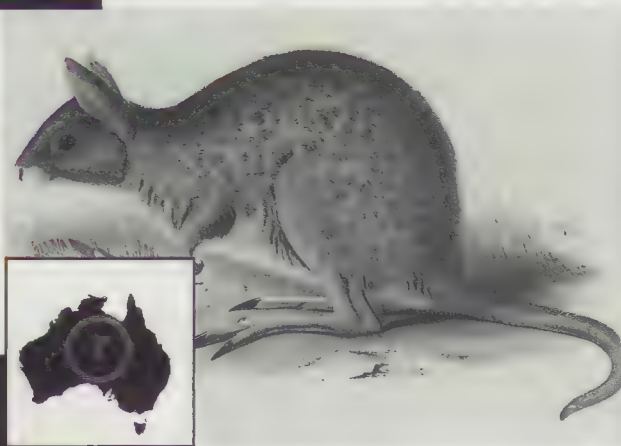
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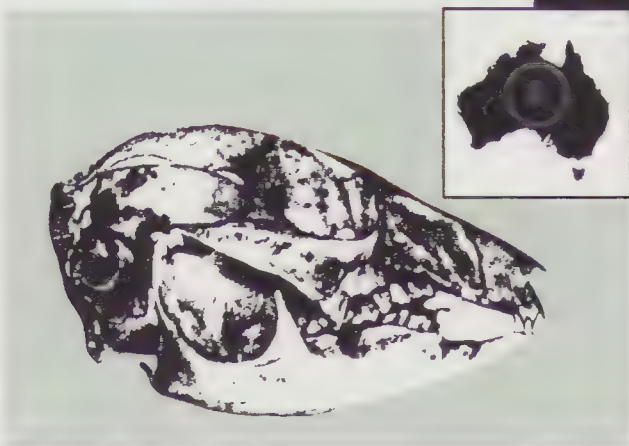
John Gould



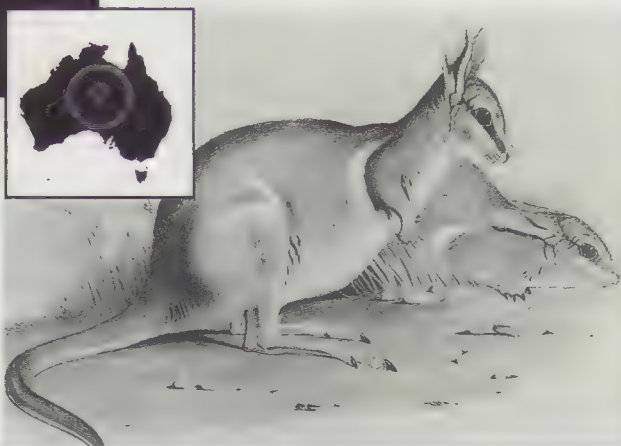
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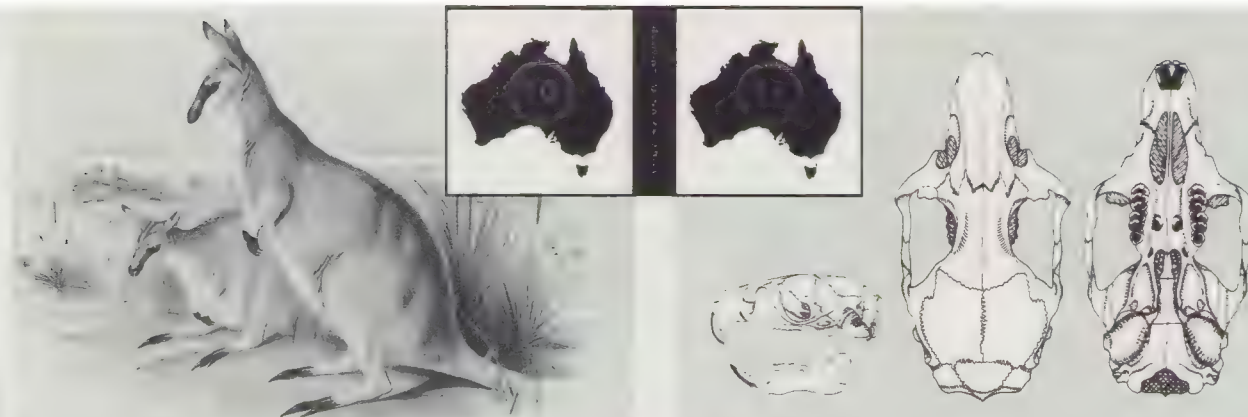
John Gould



H. H. Finlayson



John Gould



10 TOOLACHE WALLABY

Macropus greyi
Last recorded in 1927.
Range: formerly a small area of south-east SA and western Victoria.
Habitat: grasslands, often in areas of transition between light sands and richer loams and clays.

11 WHITE-FOOTED RABBIT-RAT

Conilurus albipes
Last recorded in 1875.
Range: formerly south-east Queensland, eastern NSW, Victoria and south-east SA.
Habitat: nested in hollow limbs of trees.

12 LESSER STICK-NEST RAT or TJUWALPI

Leporillus apicalis
Last recorded in 1933.
Range: formerly widespread in arid and semi-arid southern Australia.
Habitat: built large nests of sticks and stones in caves and around the base of shrubs or trees in woodlands and shrublands.

13 ALICE SPRINGS MOUSE

Pseudomys fieldi
Last recorded in 1895.
Range: only one specimen known; from Alice Springs, NT.
Habitat: unknown.

14 BIG-EARED HOPPING-MOUSE

Notomys macrois
Last recorded in 1843.
Range: only two specimens known; one from near New Norcia, WA, the other from an unknown location.
Habitat: unknown.

15 LONG-TAILED HOPPING-MOUSE

Notomys longicaudatus
Last recorded in 1901.
Range: formerly known from a few widely scattered localities near Broken Hill, NSW, Alice Springs, NT, and New Norcia, WA. Probably once widespread.
Habitat: woodlands, shrublands and hummock grasslands.

16 SHORT-TAILED HOPPING-MOUSE

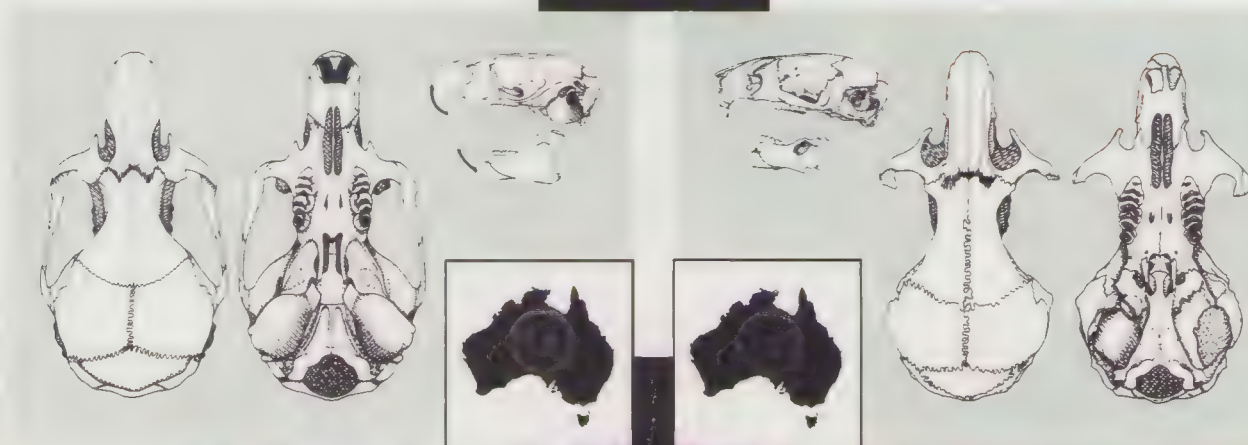
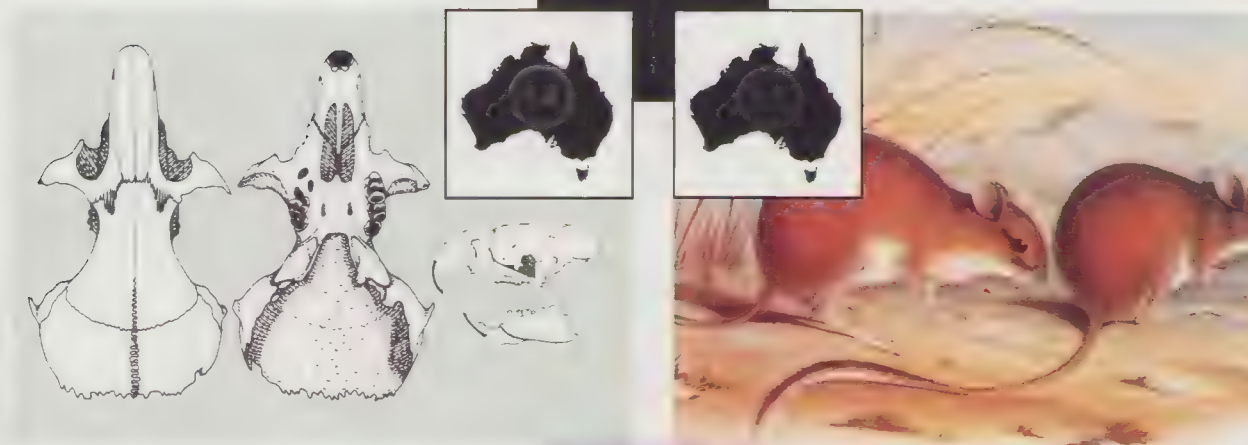
Notomys amplius
Last recorded in 1894.
Range: known only from Charlotte Waters, NT.
Habitat: unknown.

17 DARLING DOWNS HOPPING-MOUSE

Notomys mordax
Last recorded in the 1840s.
Range: only one specimen known, a skull believed to have been collected from the Darling Downs in southern Queensland.

18 GOULD'S MOUSE

Pseudomys gouldii
Range: formerly extended over much of the continent. Specimens collected from NSW, SA and WA.
Habitat: appeared to prefer plains and sandhills. Lived in small colonies in burrows lined with dried grass.



GONE, IN A BLINK OF TIME'S EYE

IN ARID AUSTRALIA over the last 200 years there has been a massive loss of native animal species.

Twenty-eight non-flying arid species of mammals are endangered or extinct. To this can be added other species — such as the brush-tailed possum — that are still common in coastal areas, but extinct or endangered in the arid zones.

This catastrophic decline has no modern parallel on other continents. It is a uniquely Australian event which has taken less than 200 years — a millisecond in geological time.

Prolonged droughts are normal in arid regions. At the end of long droughts, surface water and food are restricted to isolated refuge areas. One theory is that these refuges were special because there was extra run-off water from rocky hills. In some cases, refuges were formed where the groundwater tables were close to the surface.

Often, because of the runoff, the soil in refuge areas was slightly richer in nutrients. Extra water and nutrients create small oases where mammals could survive during droughts. With the return of the rains, desert dwellers would radiate from the refuge areas. In this way desert animals survived hundreds of severe droughts over many thousands of years.

Cattle, donkeys, camels and rabbits were also attracted to refuge areas. They ate the vegetation, and what they did not eat, they trampled. They fouled the waterholes. Their hard hooves cut up the soil and created erosion, filling the waterholes. The delicate balance between desert plants and plant-eaters, forged over millennia, was shattered.

In arid areas, the complex pattern of patch burning developed by Aboriginal people created a patchwork of areas of older vegetation and areas of vigorous young growth. The desert animals frequently used patches of older vegetation for shelter and fed on the patches of young vegetation.

The patch burning ceased when Aboriginal people were driven from their traditional country. Fuel built up and huge wildfires swept over vast tracts of the arid country. Mammals which had developed a delicate balance with the patchwork vegetation were either destroyed by the fires or found that the single-age vegetation no longer provided the variety so necessary for their continued survival.

In 200 years there has been a catastrophe. We are unsure exactly why each of the extinct species died out, but we do know that these animals are gone forever. Some of them were ordinary and some beautiful, but each was a unique part of our natural heritage.

The quality of our lives has been diminished by the loss. For the survivors, it is now a race against time and circumstances. We are in a position to alter those circumstances. We can tip the scales one way or the other.

Whether desert mammals survive depends on the choices we make. We can make choices through governments making laws to protect and conserve; through conservation agencies by making and carrying out management programs; through non-government organisations by increasing awareness and support for appropriate action; and as individuals by choosing to consume less in order to put less pressure on the environment.

CON BOEKEL

Endangered Species Unit,
Australian National Parks and Wildlife Service.

HAVE YOU EVER held in your arms an animal which is on the verge of extinction? It's a funny feeling — at once wonderfully uplifting and thoroughly depressing.

Last year in central Australia's Watarrka National Park, standing against a golden backdrop of Kings Canyon and an endless sea of silver grass, I became one of the fortunate few to hold a bilby. The bilby is a type of bandicoot, about the size of a rabbit and with seemingly endless ears to match. Gazing down at the soft bluish fur I could feel the thumping of a small and racing heart beating against mine, hear the immediacy of the breathing, and watch the dark clarity of a pair of wild eyes flicking alternately between me and the security of the spinifex beyond.

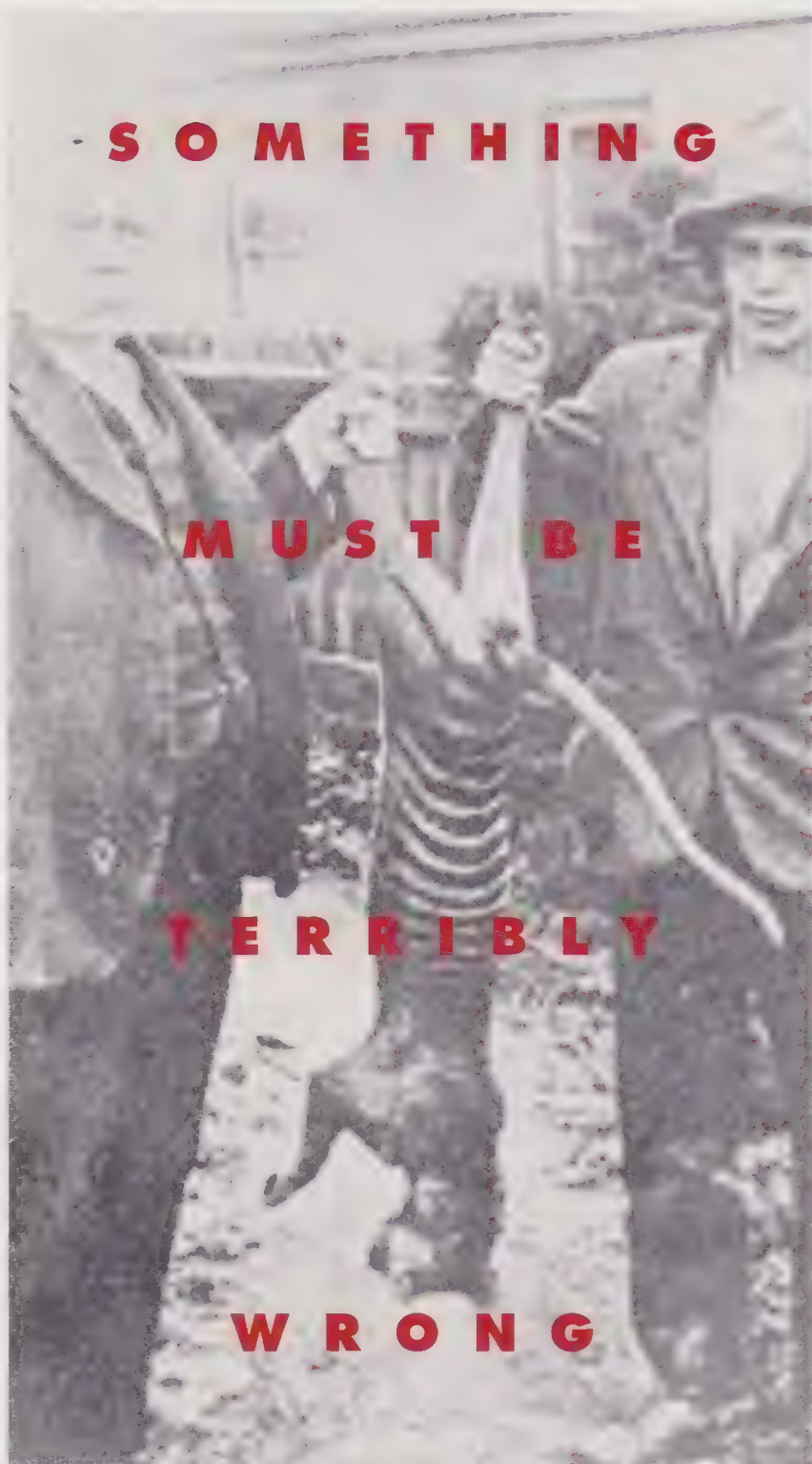
It is strange to think that life and existence is so transitory, that this wonderful genetic package is losing its grip, not only on the arid landscape of Australia, but on its place in the four billion year-long procession of life on Earth.

Extinction is part and parcel of the process of evolution. Environments change over the steady flow of time and, as they alter, so do the organisms. Opportunities arise allowing the genesis of new species and the flourishing of others. Some slowly decline, while occasionally an entire suite of organisms will go out in a rush.

The odd thing about Central Australia is that you don't get the impression that anything has really changed for tens of thousands of years, yet something must be terribly wrong. A whole fauna has collapsed within a scant 200 years. This landscape has waved goodbye to a third of its mammal species, and the areas inhabited by survivors like the bilby continue to shrink. In the last 50 years many of the mammals that lived across the arid two-thirds of the continent have either disappeared or have been reduced to small, relic populations. Many of these creatures, like the central hare wallaby and the pig-footed bandicoot, went almost before we knew they existed — certainly before we had time to understand them.

Most of the casualties have been the medium-sized mammals, those bigger than a rat and smaller than a kangaroo. But why should these animals have declined so rapidly? How can it be our fault? Talk to the zoologists and it seems there is no single major cause, more likely a cascade of smaller disturbances that made life impossible in an already difficult environment. Under critical times of drought, native herbivores would seek refuge along watercourses where nutrient-rich run-off from the surrounding country pro-

At the current rate of extinction 20 per cent of all species on Earth will be lost by the year 2000, reports RICHARD SMITH.



NATIONAL PHOTOGRAPHIC INDEX

vided more nutritious vegetation — the same watercourses along which rabbits spread and cattle survived. Not only did the native animals find themselves being out-eaten, they ended up in the stomachs of the invading predators — the ever-efficient foxes and cats.

The pattern of living began to change, as it did also for the Aborigines, who relied on many of these mammals for food. As traditional lifestyles were disrupted, so too was the old land management practice of burning. The small, regular fires lit to flush game and encourage new growth stopped. It is thought that this change further reduced the food supply and increased the distance these vulnerable creatures had to move to survive.

Biologists from the Northern Territory Conservation Commission are not sure why the bilby has hung on for longer than most, but they are determined to make sure this endangered mammal doesn't go the way of its mates. The Commission's response was to start a captive breeding program, and begin reintroducing the animals to parts of their former range. Fortunately, bilbies take to a life behind bars well, and there are now three captive populations in Australia.

The bilby I was holding hadn't seen the bush before — it was bred in Alice Springs under the watchful eye of zoologist Richard Southgate. Now, it was getting its first taste of the Great Outdoors several hundred kilometres to the south-west, in

Watarra National Park. The park was chosen because of its near pristine flora and the low density of feral animals. Nevertheless, the last time wild bilbies were seen here was back in the 1960s. Using a large wire pen as a halfway house with food and shelter, Richard Southgate has built up a new population of about 48.

It's a good sign, but there's a long way to go. A similar project with the rufous hare-wallaby (or mala) in the Tanami Desert saw an entire colony of 30 animals wiped out by a single fox in late 1987. As vital as the bilby project is, it remains a last resort.

Southgate believes it would be disastrous to breed and keep animals in captivity because that was their only option for survival. Eventually they have to be returned to the wild.

The bilby and its mammalian friends are not alone. What's been happening in Australia is being repeated around the world. At the current pace of extinction we are looking at the loss of 20 per cent of all species on Earth by the year 2000. Already 5000 animal species, vertebrates and invertebrates, are threatened worldwide, including 650 in Australia. According to some calculations, this is a thousand times the natural extinction rate. So we should be worried. Not because there will be change, but because the change is happening so fast.

We face the prospect of being at the centre of the sixth massive extinction episode in geological history. While we may debate the reasons dinosaurs succumbed to the march of time, or why in the late Permian Age the sea suddenly became no longer a good place to live, there is little doubting the cause of the current wave of genetic goodnights. For the first time in the history of the planet a single species is dominant across the globe, and

wherever humanity ranges we alter, dominate or destroy.

Our prehistoric ancestors probably began the process, perhaps with a bit of help from climate change. Paleontologists and archaeologists are turning up bones, spear tips and other evidence showing that the Ice Age megafauna were the first to be forced off the evolutionary stage. But over the last few thousand years we've chronicled it directly — the last wild bears disappeared from Britain in the middle ages, the dodo from Mauritius in 1681, the Tasmania tiger in 1934. What these records are telling us is that every year sees an acceleration in the rate that species are slipping into the oblivion of extinction.

In Australia we have passed the point of having one or two species, like the elephant or the panda, which are symbolic of the rush to extinction. You can find endangered species representing almost every habitat type in the country. Half the time we can't even be sure what we're losing, particularly when we look beyond the obvious furred and feathered animals to the myriad invertebrate, fungi and plant species. This is probably where our great-est losses are occurring.

Nobody can say how many species of plants and insects were lost as agriculture flourished across the continent. Botanists will tell you, however, that native grasslands are some of our most endangered environments. And it's only now that entomologists can make a truly educated guess of how many tens

of thousands of insect species lurk in our tropical forests. At the same time we are witnessing a possible sign of widescale ecosystem collapse — a rapid decline in our frog and native fish populations. Why? Are we killing their food supply — or poisoning their water?

In any ecosystem there will be some species that are affected by change first. In the arid region medium-sized mammals have shown they are most susceptible — the rich reptile and bird fauna remain almost intact.

The lesson to be learnt from the arid Australia is the ease with which species will reach the limits of endurance when the natural environment is already hostile. A seemingly minor change can rapidly become the last straw. The more we alienate the natural environment elsewhere, the more stress we place on the residents and the faster the extinction rate will be.

'A single species is dominant across the globe, and wherever humanity ranges we alter, dominate or destroy'

Whether we like it or not, humanity has become custodian of the future — both nemesis and saviour to creatures like the bilby. However, it wasn't until I was writing this that I glanced at a map of Watarra

National Park and noticed one of those prophetic coincidences that every now and again take you by surprise. The very much alive bilby that was wriggling in my arms had dug its way back into the sand of an aptly-named Hope Valley.

Quantum

RICHARD SMITH is a reporter with ABC-TV's *Quantum* program.

BIODIVERSITY IS BEYOND PRICE

EXTINCTION IS NOT JUST DEATH, it is an end to birth.

We can, and sometimes industry does, find consolation in the fact that extinction is a natural process, part and parcel of the dynamics of our planet. However, our Earth is now facing species extinctions at a rate many times faster than what could be considered natural.

As recently as 1989, the very year that saw the most dramatic increase in "green" consciousness in our history, a leading industry representative told a meeting of politicians, conservationists and other industry representatives, that 18 mammal extinctions in 200 years wasn't such a bad record.

Are 18 mammals, never to be born again, a fair price to pay for what the nation of Australia has achieved in 200 years? Whatever the answer, it is the price we have paid.

Of course we can't undo the past. But we can shape the future — at least to a certain extent. I add that reservation because we don't yet fully know what effect on Earth's ecosystems our vast impact is having, and will continue to have, even after we have modified some of our worst practices.

For example, how many soil organisms have gone, extinct due to our agricultural practices? What will the future implications of this be? No-one really knows. Extinction is not just about the "cute and cuddlies" and their survival. Those soil organisms, apparently insignificant, ugly little creatures though they may be, are part of the biological diversity which is the fabric of our existence.

The dance of life, the Earth's magical biodiversity, has a right to exist irrespective of how we humans feel about it. But perhaps even more pertinent to our immediate concern is the undeniable fact that our future existence depends upon the maintenance of biological diversity.

Unfortunately, we haven't nurtured our own long-term self-interest very well. Hopefully, we can start now.

The first step in doing this is by concentrating not so much on individual species — although they undoubtedly act as superb conscience prodders — but on their homes, their habitat. It has been habitat modification that has led to species loss, and it is habitat protection that will prevent, as far as possible, future species losses.

We must be prepared, for our own sakes as much as anything, to pursue our development objectives with ecological imperatives firmly embedded into them, never forgetting that biological diversity is beyond price.

Although governments control land use, and hence habitat protection, it is not a handful of government planners who hold our future in their hands, but all of us who care. Our voices, either as individuals, or channelled through organisations such as the Australian Conservation Foundation, will ensure that pressure is brought to bear on governments to act in a way that learns from past mistakes and embraces care for the land and its biological richness.

The land is not just hills and rivers, but all the living beings that belong to it, including humans. Aboriginal Australians have understood this since time immemorial, and slowly, perhaps painfully, we also need to.

Aboriginal people came to a superb understanding of the land and achieved a harmony with nature that has enabled them to survive longer than any other human society.

Maybe we too can achieve a harmony. It is harder for us because our technological prowess has the power to inflict devastation, and tends to keep us apart from nature. But this potential for harm only makes our efforts more important. If we lose them, those cuddly little critters, and the ugly ones, we lose ourselves.

MIKE KROCKENBERGER
Australian Conservation Foundation

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David Dale

I was under a misapprehension, she said. She had not had Roy stuffed and mounted on Trigger, for the reason that Roy was still alive — aged 74, running a chain of hamburger stores and actively promoting Christian causes

MONUMENTS TO THE FUTURE

MY FRIENDS USE the term “morbid” for my habit of visiting cemeteries wherever I travel. I tell them it’s a form of star spotting, and it arose because I have no luck at all seeing celebrities when they are alive. I always seem to have my glasses off when people point out Jana Wendt jogging past or Gough Whitlam in the fruit shop.

But when they’re dead, the famous can’t get away. I also claim a philosophical rationale for cemetery touring. Observing people’s monuments, I maintain, tells you a lot about them, or at least about the feelings they inspired in others.

Just inside the portals of Venice’s main cemetery, on the island of San Michele, there’s a rusty tin arrow on a stick, painted with the words: “Pound Diaghilev Strawinsky”.

Only the elite can rest undisturbed in a weedy corner along with the poet Ezra Pound (marked only by his name and a thriving bay tree) or the dance entrepreneur Sergei Diaghilev (whose marble obelisk is topped with a pair of pink satin ballet shoes — regularly renewed.)

But perhaps that sort of epitaph isn’t enough for you, and you’d like to be more visible after your death. Then get yourself stuffed and placed in a glass case, like the 19th Century English philosopher Jeremy Bentham. He’s currently seated in an obscure corridor of London University College. Some people say he’s more interesting 160 years after his death than he was in his lifetime. It’s an eerie sensation standing up close to the case to read the inscription, with Jeremy’s dead eyes fixed on you.

In requesting preservation, Bentham was following a great Italian tradition of mummifying saints and putting them on display. In Assisi, the shrivelled black corpse of Saint Clare can be viewed by those who put a few coins into the hands of a wizened nun in the church of Santa Chiara. (The squeamish can limit themselves to viewing Clare’s lacy nightie in a glass case, along with a robe worn by St Francis.) When an entire body is not available, some churches preserve portions of the anatomy. Historic hands and feet are visible all over Italy, but the most memorable such monument in my experience was an urn in San Zanipolo Church, Venice, containing the skin of a man named Marcantonio Bragadin, who was flayed alive by Turkish invaders in 1571.

Having seen Jeremy Bentham and assorted saintly spare parts in glass cases over the years, I had no trouble believing a story I was told in America about the western star Roy Rogers. The story went that when Rogers died, his wife, Dale Evans, had him stuffed and seated on the back of his horse, Trigger. The heroic pair could be viewed in a cowboy museum in the deep south.

I had a clear mental image of the tableau — Trigger rearing up on his hind legs, Roy in spangles and spurs waving a white hat — and, because of my interests in

attempts at immortality, I often thought of going in search of the museum. Then one day I was visiting the city of Atlanta, and I noticed in the local paper that Dale Evans was signing copies of her autobiography at a bookstore. I contacted her and inquired where I could see Roy and Trigger.

It was an embarrassing experience. I was under a misapprehension, she said. She had not had Roy stuffed and mounted on Trigger, for the reason that Roy was still alive — aged 74, running a chain of hamburger stores, actively promoting Christian causes, not even sick. But yes, Trigger had been stuffed when he died in 1965, and he is visible in the Roy Rogers Museum in Victorville, California.

Most people are not as lucky as Jeremy Bentham in successfully specifying how their image is marketed after death. Karl Marx never wanted the massive bust that squats in London’s Highgate Cemetery.

The poet John Keats asked that no name should appear on his tombstone, and carefully wrote his own epitaph shortly before his death. He wanted simply, “Here lies one whose name was writ in water”. As it turns out, Keats’s dying wish was thwarted by a well-meaning friend who had the tombstone made. The words on the stone actually read: “This grave contains all that was mortal of a young English poet who, on his death bed, in the bitterness of his heart at the malicious power of his enemies, desired these words to be engraven on his tomb stone: ‘Here Lies One Whose Name Was Writ In Water’. February 24, 1821.”

Keats would no doubt have envied the simplicity achieved by Martin Luther King, whose tomb in Atlanta has only this inscription: “Free at last, free at last, thank God Almighty, I’m free at last”.

Some famous graves surprise you. When I visited Hollywood Cemetery, I was expecting something on an Egyptian scale from the monument of Cecil B. DeMille, the director of movies like *The Ten Commandments*. It turns out to be just a large urn of grey granite with his name on it. But I wasn’t disappointed with the tomb of the actor Douglas Fairbanks, which has its own swimming pool and a full-size Greek temple with an epitaph engraved over the entrance in letters about a metre high. The epitaph says: “Good night sweet prince and flights of angels sing thee to thy rest”.

Compare that with Marilyn Monroe’s grave a couple of kilometres away in Westwood Cemetery: the only memorial is a small brass plaque with her name and her dates — 1926 to 1962. But there’s an extra detail: every day somebody replaces the single pink rose in a vase attached to the plaque.

To be interesting to somebody after you’re dead — that’s more important than the size of your stone. The poet Petrarch has a pink marble sarcophagus in the church square of the town of Arquà, near Padua, but the real thrill comes when you climb the hill and visit his house. The caretaker shows you the chair in which Petrarch died in the year 1374. Then he shows you the visitor’s book and you see that one of the signatories is Mozart. It made me realise that the best monument is in the minds of those who live after you. Wouldn’t you rest easily if you thought you were the kind of person who’d be visited by Mozart 400 years after your death?

DAVID DALE is a former editor of *The Bulletin*. He is the author of *An Australian in America* and is working on a book about right and wrong ways of travelling.



It will be the biggest project ever undertaken in the life sciences — and the most controversial. In laboratories around the world, scientists using powerful computers will comb through the size of the human genome directories containing the complete sequence of human DNA — the microscopic code that makes us who we are. Science claims the payoff will be huge, but the potential for genetic manipulation this project contains enzymes that the ethical debate will be

combustious. JACKIE KILENDER reports on medical science's Everest — the Human Genome Project

HUMAN

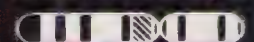
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CRACKING THE CODE

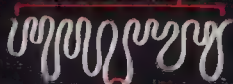
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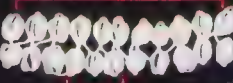
Extensive coiling and looping of DNA and proteins



Loops of DNA and protein



DNA and protein packed together



DNA entwined with proteins



DNA double helix



CRACKING THE CODE The genome is a vast library of genetic information. It is the blueprint for life. The Human Genome Project is the first step in cracking the code. The project will map the entire human genome, identifying the location of every gene. This will allow scientists to understand the role of each gene in the body and how they interact with each other. The project will also identify the mutations that cause disease and how they can be treated.

DEFINITIONS

CHROMOSOMES:

Found within the nucleus of cells in all plants and animals, chromosomes contain genes, arranged in order along their length. Cells contain two sets of chromosomes, one set from the mother and one from the father. Each species has a fixed number of sets that make up its genome.

GENES:

the basic units of inheritance which determine the characteristics of the individual. Genes are bits of information within the DNA molecule. Capable of mutation.

DNA:

deoxyribonucleic acid, DNA, is the main carrier of genetic information in living organisms. Most of the DNA of a cell occurs in the nucleus as part of the chromosomes. DNA molecules are double stranded helices, consisting of two chains wound around each other. DNA is present as a single thread-like molecule in each chromosome.

GENOME:

the genetic map or code of a living species.

PROTEIN:

proteins play a fundamental role in the processes of life. They form hair, skin, muscle and cartilage. All enzymes are protein in nature and many hormones are proteins. Proteins consist of amino acids.

THE GENETIC RECIPE

A GENE is essentially a recipe for protein — the combination of amino acids that make up a human being. Our bodies contain a range of different proteins, from the collagen of bones and cartilage, the actin and myosin of muscles, the keratin of the hair, skin and fingernails to the crystallin of eye lenses. For every protein, there is a corresponding gene, a tract of DNA-encoded instructions for assembling amino acids into a protein. Each individual has an estimated 100,000-odd genes, spread out single file along the tightly coiled double strands of DNA — deoxyribonucleic acid — which is found in the nucleus of body cells, making up our 23 pairs of chromosomes. Every cell in the body contains the same huge set of genes. If you could look at your chromosomes through a powerful microscope, the DNA would appear like two long strands of rope twisted together. If you could see deeper into this structure, you would see that linking the strands are four chemicals.

The way in which genetic information is stored in DNA is ingenious. The "letters" of the genetic code are the pairs of chemical bases which join the two strands of DNA into its graceful coil. These base-pair combinations enable DNA to act as a chemical memory bank. Each base insists on pairing exclusively with only one of the other three bases. Adenine (A) combines only with thymine (T) and guanine (G) only with cytosine (C).

The order in which these pairings lie along the DNA strand is the set of instructions for the genetic recipe. It determines the order in which the protein-forming amino acids are assembled. This in turn, determines the shape of the protein — shape, as much as chemistry, determines its biological function. It is this order that the Human Genome Project aims to find out.

As well as containing instructions to make amino acids, the gene has a set of DNA-encoded instructions that are the switches to regulate the gene's activity, ensuring that the protein is produced only in specific cell types and not in others, and only when required, and in specific quantities.

The controls on genes are essential. If all of them were constantly active, there would be chaos. Muscle proteins would clog brain cells, while lung cells would make bone proteins. It would be impossible for the organism to develop, let alone function, without the exquisite, precise control that DNA switches exert over gene function.

The amino acid sequence of a protein contains information about the DNA code of the gene that produced it. In theory, having the full sequence of the human genetic code available might enable molecular biologists to isolate proteins of medical or biological interest, and then work backwards from their amino acid sequences to identify the genes that produced them. Remember that the sequence of amino acids corresponds to the DNA sequence of the gene itself.

Unfortunately, there is a large uncertainty factor. Most amino acids have several alternative DNA codings. Working out the complexities of these alternatives is one of the tasks awaiting biologists as the human genome project progresses.

GRAEME O'NEILL



THE YEAR IS 2010. Getting the new job rests on a formality — the company's medical test. A few days after taking it, you receive a brief note from your prospective employer turning you down for the position. The blood sample taken in the medical check showed that you

had a gene predisposing you to alcoholism.

A few days later you receive advice from your life insurance company that your premium is to be increased by more than 100 per cent. The reason? Results of a recent gene analysis, recorded in a commercial computer data bank, show a predisposition to alcoholism. The data will be available to any future employer.

This is a nightmare scenario from the future. It may never happen, but the revolution in biological science underway right now could make this situation a reality in the 21st Century.

Scenario two: your family has a history of the genetic disorder Duchenne muscular dystrophy, a disease which gradually wastes the muscles. Victims generally die before the age of 30, after a life of increasing impairment. Although it afflicts only males, the disease is passed on via females. You know you have a 50 per cent chance of being a carrier, but you have never been tested for the faulty gene. Now you are pregnant. You and your partner decide on a genetic test to see if the unborn child has the disease. If it does, you must face the agonising decision of whether or not to have an abortion.

If the first case is the nightmare of a distant future, the second is closer at hand. In 1988, researchers pinpointed the gene which causes DMD, and at the Hammersmith



Purified Human DNA: a bland colourless solution containing billions of bits of information coding for human life.

PHOTO: CSIRO

Hospital in London, pregnant women already are undergoing genetic testing to determine whether their child will have the disease.

In future, however, these situations will be more common as science identifies more and more disease-causing genes — and even genes linked with particular behaviours or characteristics such as intelligence or sporting prowess. The complete mapping of the human genome — biology's Holy Grail — undoubtedly will enable medical science to provide treatments for genetic diseases hitherto incurable, as well as vastly expanding our knowledge about our evolution as human beings.

It is in treating genetic disorders that we are likely to see the information first used. Already

science has identified or come close to identifying genes which code for a range of inherited diseases and developed diagnostic tests for many of them. By the time the Human Genome Project is completed, routine pre-natal testing for a wide range of genetic disorders is likely to be offered in hospitals to those at risk of passing them to their offspring.

'Gene therapy could be used to alter the genetic blueprint of whole populations'

If disease is caused by defective genes, why not just replace or alter those genes? Recombinant DNA technology has brought scientists closer to perfecting

a range of techniques to alter the human genetic recipe in individuals. So simple and elegant in theory, the plans for genetic treatment hold the promise of curing and possibly eradicating hereditary diseases affecting hundreds of thousands of people around the world.

Does this seem a rather Orwellian prospect? Well, it could be. The ability to identify and alter human genetic material provokes ethical questions that society needs to carefully consider before the availability of the technology provides its own imperative.

Gene enhancement is the use of genetic engineering techniques to enhance a trait considered desirable. For example, adding extra human growth hormone genes to increase the height of someone without restricted growth. This has been the thinking behind early eugenics programs, which attempted to maximise human traits considered desirable in a particular race. But "manufacturing" the perfect human — or superman — would not be simple, even if scientists were willing to participate in such an experiment. Traits such as intelligence would be difficult to enhance genetically because they appear to rely on complex interactions between many different genes and environment.

Gene therapy is the correction of the effects of faulty genes. Several possible methods could be used.

Gene activation would override the function of the defective gene by activating a dormant gene with a similar function. Some genes are only active during foetal development; by birth they have "shut down". In theory, for example, single-gene recessive disorders of the haemoglobin, such as thalassaemia and sickle-cell anaemia, could be treated by activating the dormant genes which produce foetal haemoglobin.

Gene replacement therapy is the insertion of extra genetic material into defective cells to replace faulty DNA. To insert new genes, cells would have to be removed from the body and the new genes added before the cells were replaced. Several ideas for delivering new DNA into cells are proposed; the most promising involves attaching the desired gene to a harmless virus which would then "infect" the cells, inserting its own DNA into them.

Genes could be inserted in body (somatic) cells or in those known as germ cells, the reproductive cells. Most scientists recognise the great ethical difference between inserting replacement genes in somatic cells, where they could alter one individual's genes, and in germ cell therapy, where the altered genetic blueprint would be passed on to each new generation.

Human gene therapy is moving tantalisingly closer. The techniques of cell manipulation used in *in vitro* fertilisation could one day be used in human germ cell

'At the moment, no reputable scientist would be involved in attempts to genetically engineer a super race of people. But the trend is for more scientists to become personally involved in commercialising the products of their research. Commercial pressures to genetically engineer new Mozarts, Michelangelos or super-athletes might be enormous'



CSIRO

WHERE DID a plan of such scale as the Human Genome Project have its genesis? The first serious proposal to sequence the entire human genome was presented at a meeting at the University of California in Santa Cruz in May, 1985.

The idea gained momentum when cancer researchers in the US pointed out the gains that could be made in understanding cancer from a complete sequence of the human genome — cancer is fundamentally a disease resulting from the abnormal activity of genes, usually as a result of subtle mutations.

In 1986 the powerful US Department of Energy became interested in the project, through its Office of Health and Environmental Research.

The DOE's interest was in gaining more information about the effects of radiation on genes. Not long after, the biological research community began considering its own genome project, because it was concerned that the DOE genome project would be managed by physical scientists, rather than by biologists.

Professor James Watson, co-discoverer with Francis Crick of the structure of the DNA molecule, proposed that the National

whose code serves to check and maintain the integrity of the genome during the lifetime of the individual, and from generation to generation. The cost of sequencing one DNA base currently

stands at about US\$1, after declining rapidly with the technological advances of the past decade. That would put the minimum cost of obtaining a complete

sequence at US\$6 billion, excluding the cost of purchasing the hundreds of sequencing machines it would take to complete the task within a decade.

The project is unlikely to proceed at full pace until machines have been developed that can sequence 20,000 bases per day at a cost of no more than 10 cents per base.

In mid-1990, the International Human Genome Organisation (HUGO), headed by Dr Charles Cantor, of the DOE-funded Lawrence Berkeley Laboratory in Berkeley, California, began co-ordinating the mapping program. HUGO will be responsible for determining which laboratories around the world will sequence particular chromosomes or segments of chromosomes.

Laboratories in the United States, Europe and Japan have all expressed an interest in the project. One Australian already has been told he will work on the project — Dr Grant Sutherland, chief cytogeneticist at the Adelaide Children's Hospital. He is receiving a US Government grant of \$1 million over two and a half years to the end of 1991.

The project will begin with the construction of a physical map that will allow each DNA sequence to be located on the 23 sets of human chromosomes as it is completed.

A list of the world's 100,000 largest cities and towns would be useless to a traveller without a map indicating in which countries they occur, the distances that

Institute of Health, headquartered in Bethesda, Maryland, should also participate in the project.

As interest increased, a special committee of the National Research Council began investigating the feasibility of a human genome project, and in a unanimous report in 1988, urged the US to work co-operatively with other nations that wished to participate. At the same time, the Japanese Government was moving to encourage similar research in molecular biology with its Human Frontier Science Program, an international program which offers grants to researchers worth an anticipated one trillion yen over 20 years.

Some idea of the complexity and scale of the Human Genome Project can be gained from the way it must be organised, and the advanced technologies that will be required to complete the task within reasonable time, and reasonable cost.

In the early 1970s, a molecular biologist working basically manually might take a whole day to sequence just 10 DNA bases in a gene. In 1990, the fastest semi-automatic DNA sequencers can decode some 12,000 bases in a 24-hour day.

Yet even at this rate, it would take a machine nearly 700 years, working day and night, to sequence the three billion DNA bases in the human genome. In fact, it would take 1400 years, because the plan is to sequence both DNA strands — the one bearing the vital genetic code, and the so-called template strand,

separate them, and other geographic features.

So it is with the Human Genome Project: it will sequence and catalogue the 100,000-odd genes on the 23 pairs of human chromosomes, but without a physical map of where and in what order they occur in each chromosome, the information will be of little use.

When molecular biologists have both a high-resolution map and a full sequence for the human genome, the task of matching proteins to genes will probably take only a few hours, rather than months. The protein's amino acid sequence will be analysed, and a short tract of DNA code inferred from this sequence will be fed into a computer, which will search the genome to find the gene in which it resides.

The computer would also identify the nearest genetic markers — landmarks in gene geography — on either side, pinpointing the gene's location on a particular chromosome. The molecular biologist would then be able to do a one or two-step reconstruction to assemble the complete gene for experimentation.

Numerous markers have already been identified in more than a decade of exploration — they include specific genes, short sequences of non-coding DNA that lie close to as-yet unidentified genes implicated in genetic disorders, and long, apparently meaningless tracts of a particular DNA sequence, repeated many times over.

The biological road back to our beginnings



CSIRO

Professor Watson says that over the next five years, groups of up to 50 investigators each must be established to oversee the physical mapping project, and later, to sequence the individual chromosomes, a process that could take a further 10 years. On that schedule, a detailed physical map of the human genome could be available by the mid-1990s, and a complete sequence by the year 2005.

Essential to describe the geography of the genome is a universally-accepted set of terms. This was looming as a major obstacle to the project. Then three scientists — Dr Maynard Olsen of Washington University, working with Charles Cantor and Dr David Botstein of the biotechnology company Genentech — proposed a system for developing a map that would take the valuable data already gathered by research groups using different systems, and merge it into a single, universally recognisable form.

While the Human Genome Project is still in preliminary stages, scientists wanting to find the sequence of certain genes still have the problem that often these genes lie between markers hundreds of thousands of bases apart. An example of the inherent difficulties of this is the tale of the cystic fibrosis gene.

In 1985, North American geneticists identified a marker on human Chromosome 7 that seemed to be weakly linked with the genetic disease cystic fibrosis. Using the marker as a starting point, they "walked" along the chromosome in either direction until they arrived at a gene that seemed a promising candidate because of the characteristics of its protein product.

It was indeed the cystic fibrosis gene. But the route they took to find it is cumbersome, costly and very time-consuming — several large teams of molecular biologists, comprising 40 to 50 scientists and technicians, worked for more than two years to locate and identify the gene.

The Human Genome Project will make chromosome walking more efficient. The huge data base of the human genome and its associated high-resolution map should rapidly repay the cost of the Human Genome Project, by providing substantial savings in the time and cost involved in searching for genes.

Before the human genome can be mapped and sequenced, it will be necessary to break it up into conveniently-sized chunks, using special enzymes which cut the DNA at certain points. A problem inherent in sequencing a single set of fragments is that there is no way of knowing how each fragment lines up head-to-tail with adjacent fragments to form the complete DNA molecule because none of their sequences overlap.

The solution is to map a second set of fragments. The first sequencing reveals nothing of how the fragments relate to each other. The second round, using enzymes that cut at different sites, yields a new set of fragments that are sequenced individually. Using a powerful computer program, molecular biologists can scan the code of one set of fragments, looking for combinations that span the cuts made by the other run. By cross-referencing the two sets of fragments, the complete code of the original can be assembled.

GRAEME O'NEILL



"supermice" — but so were many of their offspring.

Several problems remain. For a start, scientists presently have no control over where on the DNA strands the new gene would be inserted, and the quantity of cloned copies of the gene that would be produced. Gene therapy would be useless if not enough of the desired gene product were produced, or too much, or if the replacement gene were accidentally inserted in the midst of a sequence coding for a desirable gene product.

There are other difficulties, too. Certain genetic illnesses actually produce positive effects. Those who develop sickle-cell anaemia have two copies of the defective gene in their chromosomes. But for those who inherit only one copy of the sickle-cell gene, it confers a better ability to survive malaria — a disease common in those parts of Africa where sickle-cell disease also is endemic.

Genetic screening is the examination of a person's genetic code to see whether he or she will develop or transmit an hereditary disease or defect. Inevitably, mapping the human genome will spur biologists to identify the function of each gene and their interreactions. Once a function is linked to a gene, its presence or absence should be able to be tested in blood, amniotic fluid or other tissue sample.

The diagnosis and treatment of genetic illnesses is the goal of medical scientists interested in using the emerging genetic engineering technologies. The uses for these technologies are likely to be limited initially to single-gene diseases. But as we gain understanding of traits or diseases dependent on the interplay of several genes — polygenic traits — new vistas open up.

Many of these new horizons are alarming to scientists and ethicists around the world. A danger inherent in knowing the genetic formula which causes human character traits is that we — or our governments or doctors — might decide some are "undesirable". We might try to eliminate those traits considered unsuitable to the race. By pinpointing people with "undesirable" genes, genetic screening could be eugenic. Application of germ cell gene therapy could be used to alter the genetic blueprint of whole populations.

Certainly, fears that nations will try to create a "master" race seem unlikely to be realised. But the implications of genetic treatment programs are far-reaching.

Consider this scenario. A national computer registry is established to record the results of routine genetic screening at birth. By identifying those needing treatment for a genetic disease, it saves millions in health costs. The registry can be consulted by couples wishing to have children who then have the option of using donated sperm or eggs to conceive, to have a therapeutic abortion or to consider germ cell gene therapy if their offspring is likely to have a genetic disorder.

Yet what happens if people begin to consult the register to abort otherwise healthy offspring who don't fit into their idea of a perfect child? Selective abortion of female fetuses — as a result of pre-natal diagnosis techniques — recently has caused concern among doctors. How tempting would it be for parents to abort an unborn child carrying genes that would predispose it to cancer in later life? In fact, some lawyers have suggested that in future, sophisticated genetic screening

WE ARE OUR GENES

WHAT MAKES human beings different from other animals? What makes us similar? Do we, as evolutionary theory predicts, share a relatively recent ancestor with the great apes and all other mammals? Could we slow down the ageing process and achieve control over such scourges as cancer, premature senility, heart disease and viral diseases? Can we hope to cure lethal genetic diseases such as Duchenne's muscular dystrophy, cystic fibrosis and thalassaemia? Could we extend the average human life span beyond a century?

Such questions have tantalised and challenged 20th Century medical science, and their answers almost certainly lie in the 21st Century.

Humans have been shaped by nature, by the forces of natural selection. Our genes determine how we respond to the daily challenge of living. The process can be described by a deceptively simple equation that says, in essence, that we are the sum total of the interactions between our genes and our environment. If we want to know what we are, we must understand both components of the equation. In 1990, biologists are planning an enormous project that will throw new light on human genetics. Within two decades, we can hope to know how many genes make a human being, to have deciphered the complete DNA code that makes up every one of those genes, and to have constructed a map describing how the human genome, the entire set of our genetic information, is organised.

The human DNA sequence map would take the form of a huge computerised data base, containing as much information as 4000 Melbourne telephone directories. This mass of data will be quite useless and unwieldy in its raw form. Biologists will give it form and meaning with the assistance of powerful computers.

Using highly automated DNA-sequencing machines linked to computers, scientists will dissect and record the estimated three billion letters of the genetic code that constitute nature's instruction kit for making a human being.

There is no doubt that the data will be of enormous and enduring value. For all the expense and effort it will involve, the task of mapping and sequencing the human genome is just a beginning — scientists centuries hence will still be plumbing the depths of its riches.

For two decades, molecular biologists have devoted most of their energy and resources to the slow, immensely difficult task of identifying, isolating and cloning genes of interest. So far, only about 4,500 out of the estimated 100,000 to 300,000 human genes are known. The completion of the Human Genome Project will make identifying and cloning genes a routine, almost simple matter.

The Human Genome Project will elevate the science of human genetics to a new plane and, in the largest project ever undertaken in the life sciences, will retrace humanity's evolutionary past, as well as open a window on to our genetic future.

The focus in biology will shift to understanding what specific genes do. The early decades of the new millennium promise unprecedented progress towards identifying and understanding the genes that co-ordinate the development of a complex, sentient human being from a single cell. Medical science will gain new insights into the genetic errors that lead to cancer, genetic disease and ageing.

GRAHAM O'NEILL

Science and Technology writer for *The Age*

IT'S NOT EXACTLY NEWTON

WE HAVE worked on DNA for a total of 22 years between us, so we feel able to make some comment on the advisability of the Human Genome Project. Here are precisely the kind of results that the Human Genome Project is going to generate:

20310312022311023031020301023012
30103030211102321300210312033012
00102220201103203103203101230103
20103021332013002110312201032103
2031302110202201302031031202231
10230310203010230123010305021110
23213002103120330120010223020110
32031032031012301032010302133201
30021103122010321032031302110202
22013020310312022311023031020301
02301230103030211102321300210312
03301200102230201103203103203101
23010320103021332013002112021313
00230302103020103021032132310213
20310320310123010320103021332013

We have stopped after just 500 characters, so as not to waste space. The Human Genome Project plans to be less concise than us and list a semi-random series of the four numbers 0, 1, 2, 3 for many millions of characters. Such a list, which does not have any natural punctuation or spaces, would completely fill the phone directory of New York City, several times over.

Although some rules exist to make sense out of about one per cent of these data, 99 per cent will be without meaning for many, many years to come, perhaps forever. The Human Genome Project has little scientific character.

Why, then, do certain scientists in the US support such a project if it is of little scientific value? It is hard for us to say, because we do not fully understand human psychology. All we can say is that, of the few people we have met who support the project and are going to be supported by it, all of them stand to benefit from it in terms of either personal prestige, laboratory equipment, or in direct financial gain.

All of the great discoveries in biology, and indeed in most other fields of science, have come from the creativity and persistence of individual men and women, working singly or in small groups. Many great biologists, such as Kornberg, Brown, Sanger, Perutz and Crick, have written of this.

The Human Genome Project, when implemented, will largely soak up the research support that should in fact go to these small, efficient, creative groups. Already, even before the project begins, research support in the US has dwindled to the point where just 12 per cent of research proposals by these individual investigators is being funded.

What will humankind get for its relatively large and nearly purposeless investment in the Human Genome Project? Simply a 20th Century version of The Egyptian Book of the Dead, that will not exactly inspire in future generations an awe of the intellectual powers of their ancestors.

**DRs H.R. DREW and
M.J. McCALL.**
CSIRO Division of
Biomolecular
Engineering.



techniques might make it a crime for parents not to abort such children. A legal ethical debate is inevitable.

The potential uses of genetic screening also alarm many civil libertarians. The insurance industry took only a few years after the availability of a reliable test for AIDS, the deadly Acquired Immune Deficiency Syndrome, to insist on testing applicants for some life insurance policies. Insurance companies are almost certain to press for access to sensitive data about individuals' genetic constitution were it to become available.

The Life Insurance Federation of Australia, the industry's umbrella body, is keeping a close eye on developments in this area; it believes that if people taking out policies can find out information which has a bearing on their risk rating, then insurers ought to have the same level of access.

Government agencies, the police, immigration authorities and employers all might have an interest in knowing about a person's genetic make-up. Employers may find the availability of genetic screening tests irresistible as a means of ensuring a reliable workforce. Pre-employment genetic screening already is used by some large companies in industrial nations. In fact, last century, fair-skinned workers were rarely employed in tar and creosote factories. It was known that these substances caused higher levels of skin cancer in those who worked with them — and fair-skinned people apparently were most at risk.

What would happen if employers routinely rejected workers because of the possibility that they might develop a trait that would make them less desirable as workers? Genetic screening could prevent much occupational disease. But if employers used it in place of changing dangerous work practices, or if they discriminated on the grounds of tenuous links between certain genes and undesirable traits, it would be a regressive step.

The example at the beginning of this article illustrated some further questions posed by genetic screening of large portions of a population. Who keeps the genetic records? Who has access? Might commercial organisations be able to keep a genetic "risk rating" data bank like existing credit rating data banks?

No specific controls currently exist to prevent organisations gaining access to sensitive genetic information on individuals. Controls on genetic manipulation techniques, however, do exist. Victoria was the first State in the world

Computer enhanced image.

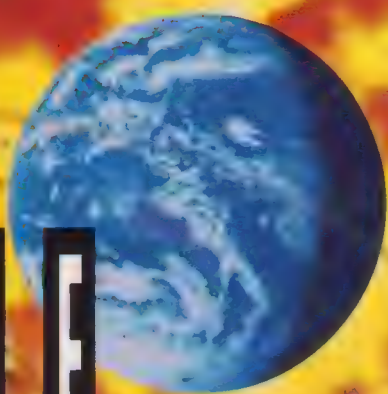


Above view of DNA Molecule.

to pass laws regulating the new embryo manipulation techniques used in *in vitro* fertilisation. It forbids embryos to be created specifically for experimentation and requires proposed experiments to be approved by an independent panel. Britain likewise has developed legislation to control experiments on early embryo cells. Research in the United States is subject to scrutiny from a range of funding and supervisory agencies.

JACKIE ALLENDER is a freelance medical journalist.

SPACE



SHOTS OF

THE PLANETS

Tear up your old text books and encyclopaedias, space voyages have revolutionised our view of the planets, including our own.

MISSION TO PLANET EARTH

Forests are falling, deserts are spreading, toxins are accumulating in earth, air and water, and the climate is taking a turn for the worse. Our sick Earth is becoming increasingly inhospitable to humans. Past efforts to manage the planet have been inhibited by lack of knowledge of the Earth's systems, but hope is now on the horizon in the form of a multi-billion dollar international endeavour to monitor the health of the Earth from space. From 1997 a series of spacecraft and platforms will beam back the data scientists and others need to see the big picture. KARINA KELLY reports on the Mission to Planet Earth.

WHY ON EARTH do we need a space mission to our own planet? The answer is that we still don't know how the Earth works as a system.

We don't know if a small change in the atmosphere — for example an increase in carbon dioxide — will cause a drastic and permanent change in the Earth's climate. We don't know how cloud patterns, vegetation or ocean circulations will change, nor what impact these changes will have. It's about time we found out. Until we do, we're giving politicians and industrialists the excuse they need to do nothing about the parlous state of the biosphere.

Scientists are working on climate models which will help to predict the future, but they vary widely in what they predict because they lack sufficient information.

Mission to Planet Earth is designed to give decision-makers the information they need to make the right decisions about energy policies, deforestation, farming practices, and anything we do that affects the biosphere.

The information will not come cheap. Up to \$40 billion will be needed to launch space platforms and satellites and to process the huge volume of data they will send back over a 15-year period.

The mission will be watching biological changes on a global scale as well as picking up what's going on in minute detail — over even just a few metres. Deforestation, desertification and plant stress will all be monitored. This way, it's hoped we'll be able to pick up small changes before they become large disasters. So, if plant and animal life is suffering in a region for any reason, Mission to Planet Earth should find it. Above the surface of the Earth, we need to monitor changes in the atmosphere — for example, a depletion in stratospheric ozone.

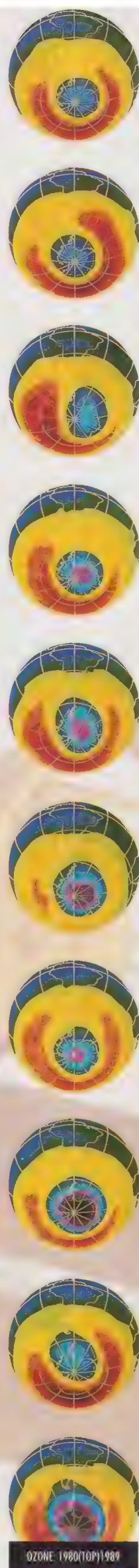
The first stage, the Earth Observing System (EOS), has been in development since 1983. It consists of a series of polar orbiting platforms about 700 kilometres above the Earth which zip around the globe about 15 times a day, covering the entire surface of the Earth every three to five days — rather like winding a ball of wool. The large platforms, carrying an array of instruments, are important because many different measurements need to be taken at the same time.

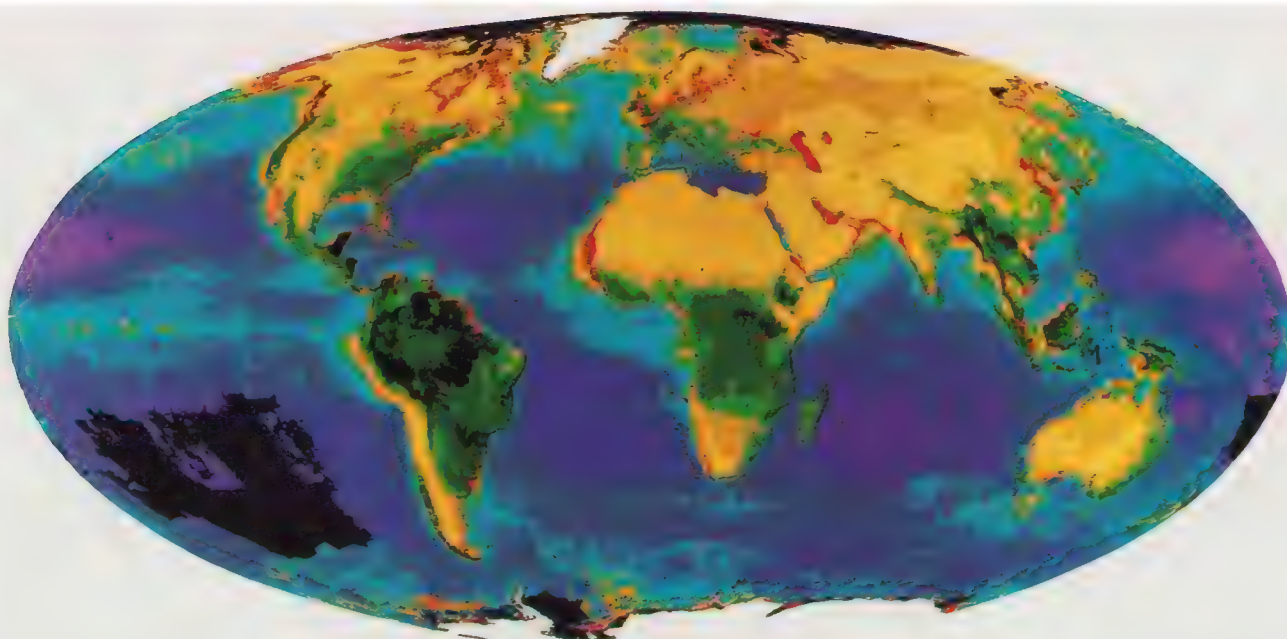
The first polar platforms, NASA's EOS-A and the European Space Agency's ESA EPOP M1, are both due to be launched in 1997. EOS-A, a 15-tonne craft, will be launched on board a Titan IV booster carrying 19 instruments.

Among them will be AIRS, an atmospheric sounder which will measure the Earth's outgoing radiation; HIRIS, a high-resolution imaging spectrometer which will provide images of the Earth on a scale as small as 30 metres; MODIS, a moderate resolution imaging spectrometer to measure biological and physical processes on a one-kilometre scale with emphasis on the study of ocean primary productivity; ITIR, an intermediate thermal infrared radiometer, which will image clouds and their radiative role, classify rock types and study volcanology. These are just a few examples of the dozens of highly specialised instruments being planned for the mission.

While the full-blown Mission to Planet Earth has not yet won approval for funding, at this stage of planning it would also include payloads attached to the planned Space Station Freedom. There would be a series of Earth probes, in low equatorial orbit, flying between 400 and 1,000 kilometres above the planet. They would circle the Earth every 90 minutes, carrying specialist equipment not possible on the polar orbiting platforms.

A hundred times higher, at a distance of nearly 40,000 kilometres, will sit five geostationary platforms. The advantage of these is that they orbit at a speed which matches the rotation of the Earth, so they always





LEFT: this composite image shows the amount of vegetation on land and in the sea. In the oceans, the red and orange areas have the greatest concentrations of phytoplankton, and on land the densest areas of vegetation are in green tones. This information was slow to gather. It took NASA's Nimbus 7 satellite more than 20 months to collect the ocean data and a separate satellite, the NOAA 7, three years to gather the land information. The data systems of Mission to Planet Earth aim to produce this kind of image in real-time.

look at the same area of the Earth's surface. Then there are the suborbital rockets, balloons, aircraft, and ground stations.

All of this hardware will monitor the heartbeat and pulse of the Earth. We will learn how carbon dioxide and other greenhouse gases are increasing in our atmosphere and which mechanisms work most effectively as carbon "sinks". We'll be able to monitor temperatures in the air and on the surface of the sea and the effects any changes in temperature have on cloud cover and wind speeds. We'll find out, in great detail, what is happening to the ozone layer, which not only has a hole over Antarctica, but definite signs of the same chemical reactions occurring over the Arctic.

The other vital part of the mission is its data processing. We need to find new and better ways to process the information in a way that registers change. If Mission to Planet Earth had been in operation when the ozone hole had first appeared, we would have been alerted to it immediately.

But the volume of data they can expect from the hundreds of instruments that will operate over the 15 years of the mission is mind-boggling. When Mission to Planet Earth is fully implemented, it will collect more data in one week than all of humankind's recorded history.

This means that new ways to deal with data will have to be devised, ways that allow observers to discern changes. The data system alone is expected to cost

between \$US7-8 billion by the end of the decade.

Mission to Planet Earth is part of something larger — the International Geosphere Biosphere Program organised by the International Council of Scientific Unions. 1992 is International Space Year and NASA is pushing for particular emphasis on the study of the Earth. So while the moon missions captured our imagination in the 1960s, Mission to Planet Earth may just recapture our future.

The research groups working on Mission to Planet Earth will have immediate access to all the information

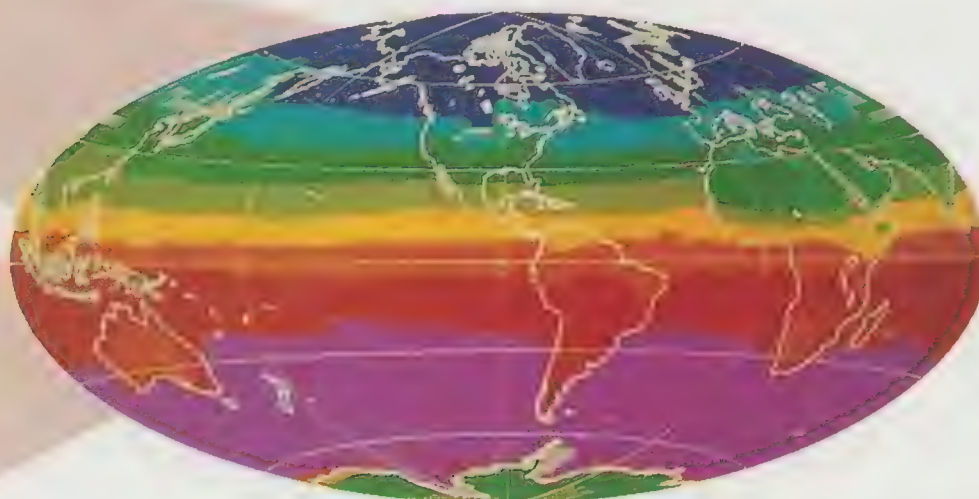
'We'll be able to pick up small changes before they become large disasters. If plant and animal life is suffering in a region for any reason, Mission to Planet Earth should find it'

coming in. Those who devise the experiments won't have a period of exclusive access as is often the case, so everyone will be as up to date as possible about the changing nature of the biosphere.

For this we need serious international cooperation and indeed, the mission will be the most international ever undertaken. While the bulk of the equipment will be built and launched by the United States, spacecraft, instruments and data systems will also be contributed by Europe (through the European Space Agency), Japan and Canada. Australia and Brazil will also be involved in data analysis, ground-based measurements and prediction. Discussions with the Soviet Union are still continuing.

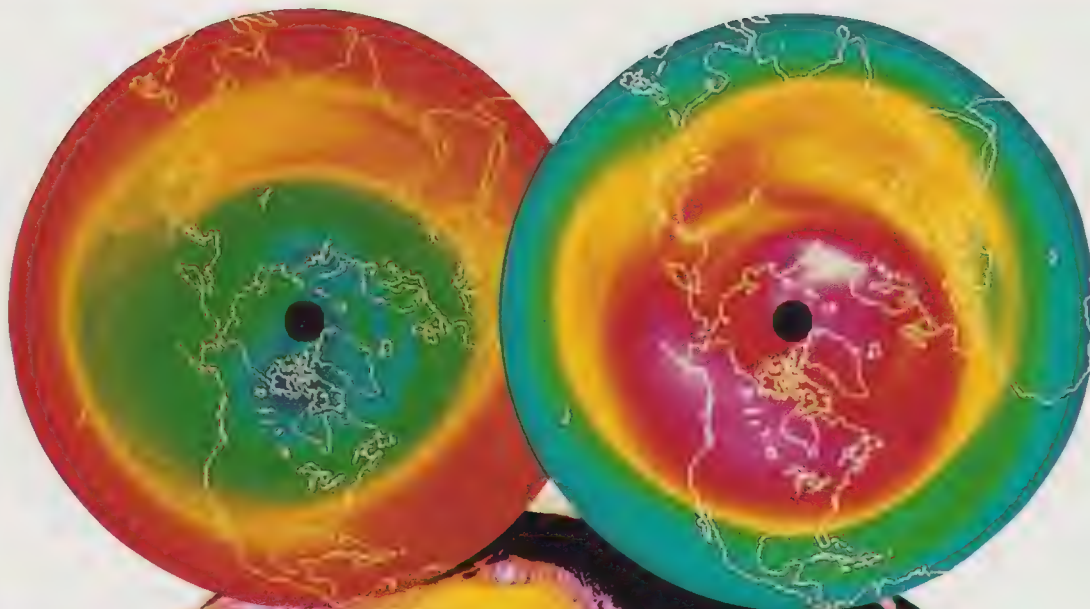
KARINA KELLY is a reporter on ABC-TV's *Quantum* program.

FAR LEFT: this sequence of images illustrates how the hole in the ozone layer over Antarctica has grown year by year from 1980 (top) to 1989 (bottom). The data were collected by the LIMS sensor in successive Octobers. Ozone levels increase from purple through yellow to red. The reduction in the protective ozone in the stratosphere is being caused by human-made chemicals such as chlorofluorocarbons. The build-up of ozone in the tropics contributes to the Greenhouse effect and is the result of fossil fuel burning and industrial pollution. The Earth probe TOMS — Total Ozone Mapping Spectrometer — will provide ozone data until the mid to late 1990s when new satellite instruments will take over the watch and provide global-scale measurements.

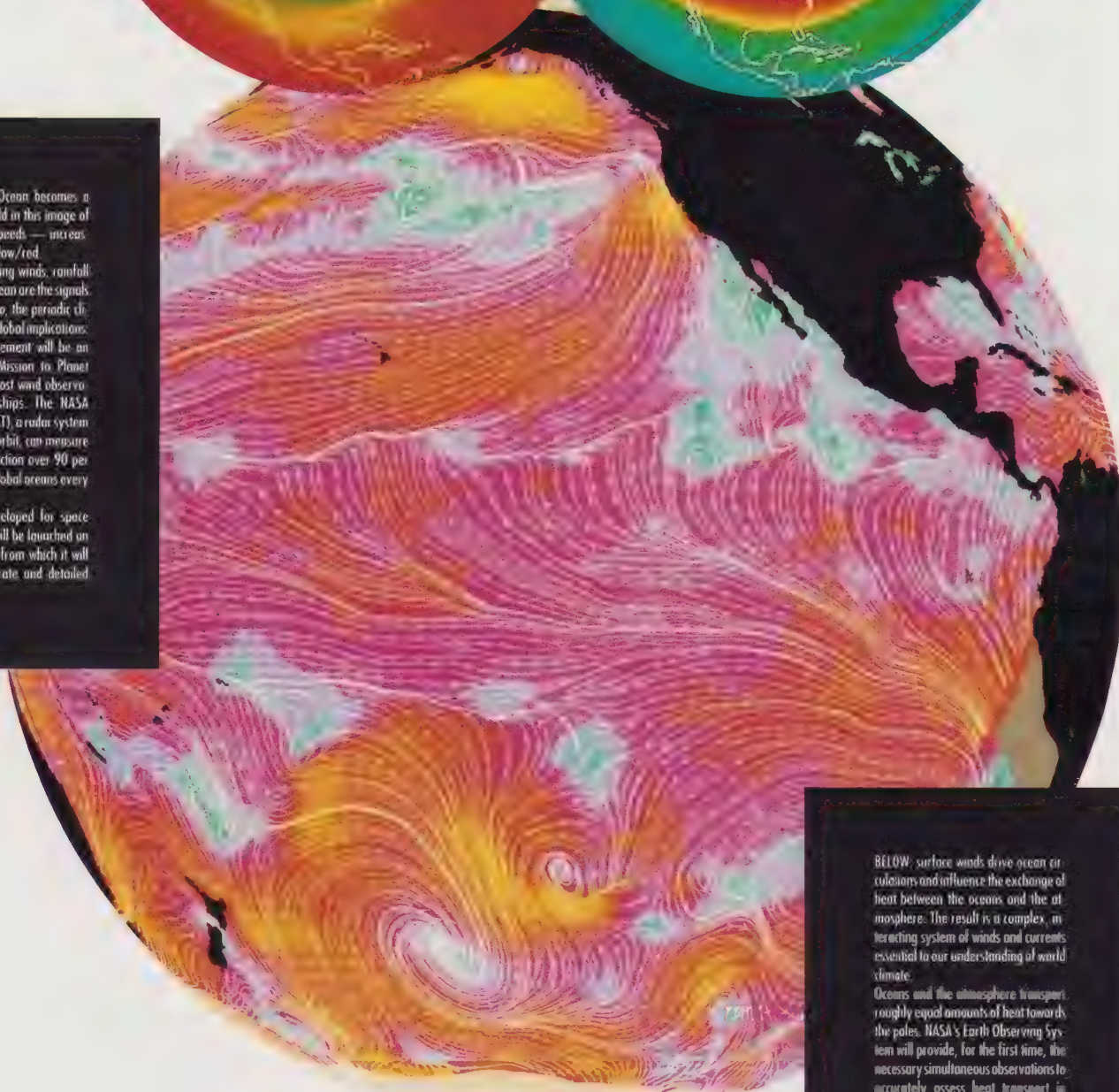


LEFT: The blue/green areas of the image show where radiant heat is lost from the Earth during the northern winter. The magenta/red areas display a net heat gain in the northern summer. The energy balance of the Earth's climate is determined by the balance between absorbed and emitted radiation. This balance can be best observed from space. Earth observing system instruments will provide complete hemispherical coverage of the Earth's radiance patterns.

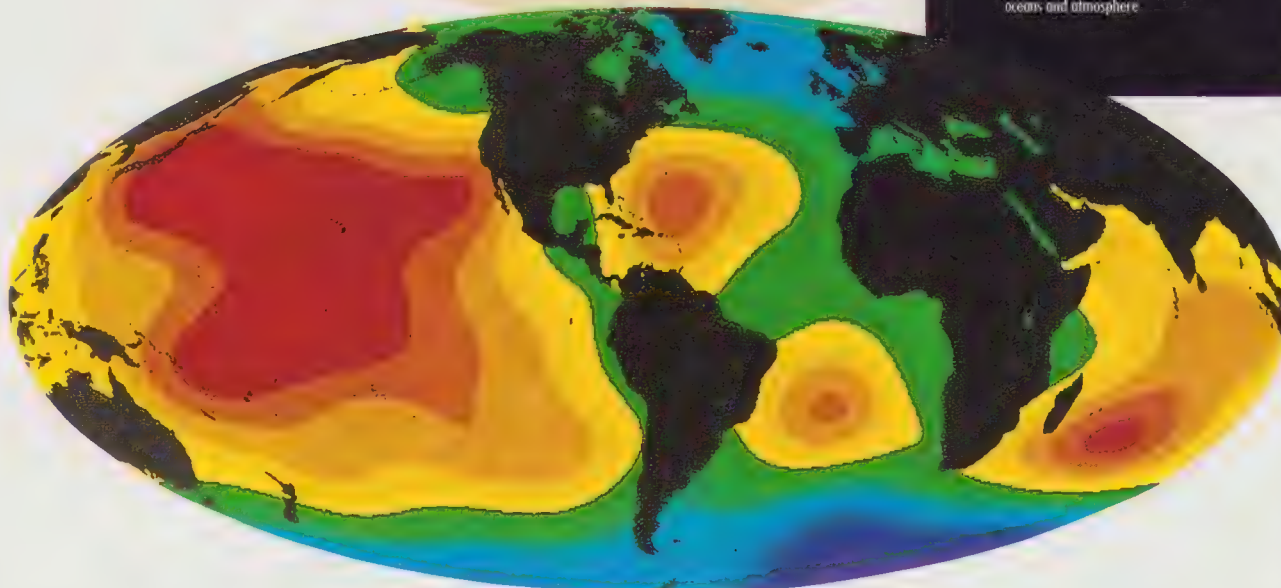
RIGHT: the image on the left displays nitrogen dioxide levels in the atmosphere in 1979. On the right are nitric acid levels in the same year. The levels increase from blue/green to red. Acid rain will be targeted by the UARS — Upper Atmosphere Research Satellite — planned for launch in 1991



RIGHT: the Pacific Ocean becomes a swirl of pink and gold in this image of wind patterns and speeds — increasing from blue to yellow/red. In the Pacific, changing winds, rainfall and heat from the ocean are the signals and causes of *El Niño*, the periodic climate anomaly with global implications. Ocean wind measurement will be an important part of Mission to Planet Earth. At present, most wind observations come from ships. The NASA Scatterometer (NSCAT), a radar system in sun-synchronous orbit, can measure wind speed and direction over 90 percent of the ice-free global oceans every two days. NSCAT is being developed for space flight and in 1995 will be launched on a Japanese satellite from which it will transmit more accurate and detailed data.



BELOW: surface winds drive ocean circulations and influence the exchange of heat between the oceans and the atmosphere. The result is a complex, interacting system of winds and currents essential to our understanding of world climate. Oceans and the atmosphere transport roughly equal amounts of heat towards the poles. NASA's Earth Observing System will provide, for the first time, the necessary simultaneous observations to accurately assess heat transport in oceans and atmosphere.



'When Mission to Planet Earth is fully implemented, it will collect more data in one week than all of humankind's recorded history'

THE HOLE THAT WON'T GO AWAY

THE OZONE layer in the Earth's stratosphere shields life on the planet from excessive ultra violet solar radiation. A hole in the ozone layer over Antarctica was discovered in 1982, but the finding so shocked scientists that they checked for two years before releasing the information. By 1987, the hole was the size of the USA and as high as Mt Everest. At its centre, 97.5 per cent of ozone was missing.

Since then the hole has grown dramatically. Scientists have shown that chlorofluorocarbons, propellants, used in aerosol cans and in refrigeration until their use began to be phased-out in 1987, were mainly responsible for ozone destruction.

CFCs slowly make their way upwards to the stratosphere, where they remain for decades, even centuries. Under the right circumstances they break down into their constituent parts, one of which is chlorine, a powerful destroyer of ozone.

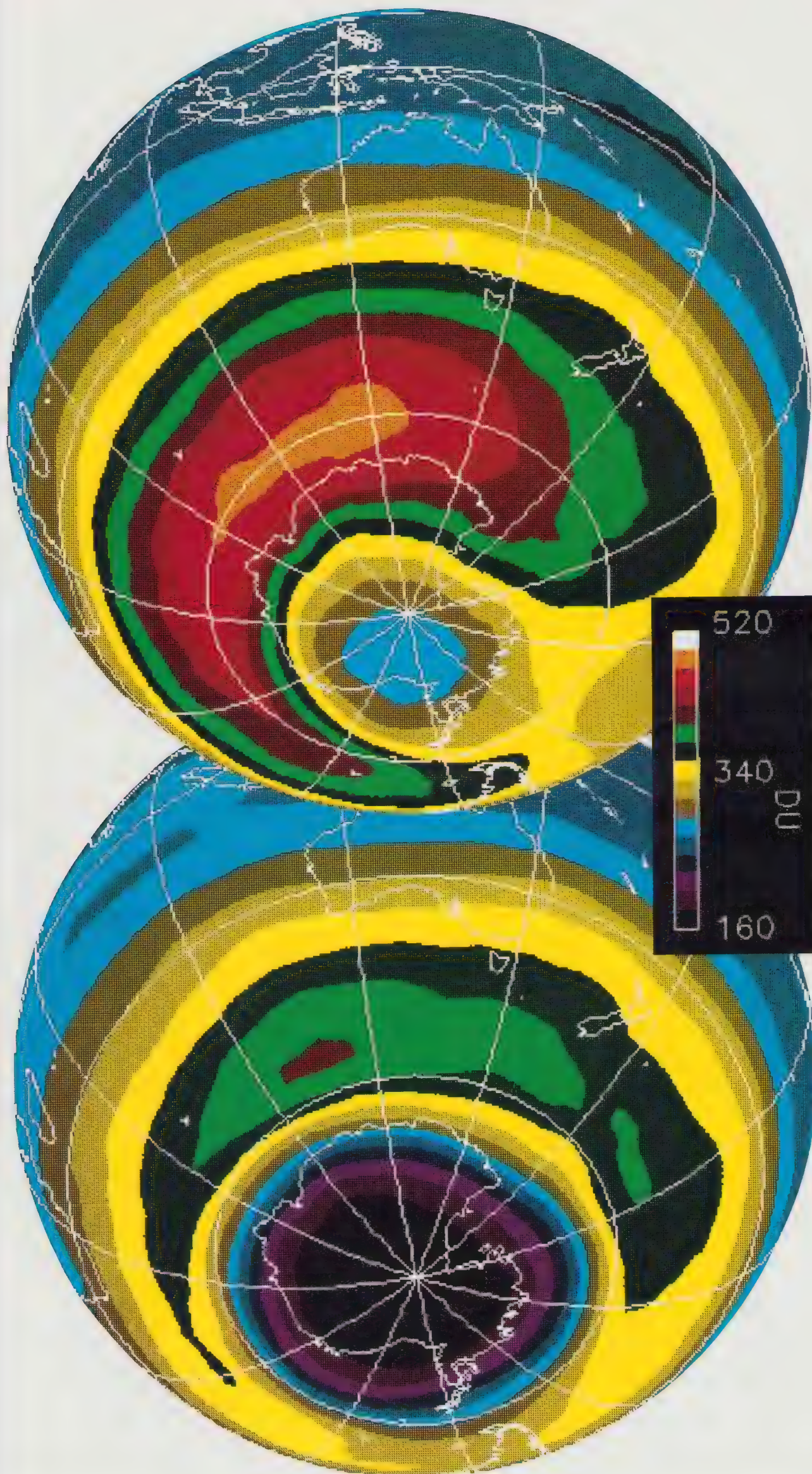
The danger to the ozone layer can be assessed by the amount of chlorine in the stratosphere. The natural level of chlorine is 0.6 parts per billion (ppb). When the Antarctic ozone hole first appeared there were between 1.5 and 2.0 ppb of chlorine in the stratosphere. The level is now 3.0 ppb.

Ozone is destroyed over Antarctica in winter and spring when the polar vortex reduces temperatures and excludes other weather systems. Large ozone holes are not occurring away from the poles because weather conditions necessary for ozone destruction do not occur. In April 1990, NASA published the results of flights over the Arctic in 1989 which showed that an ozone hole is beginning to appear over the north pole as well.

Scientists predict that exposure to increased UV radiation could suppress the human immune system, cause eye damage and skin cancer. Plant growth would be affected and the food chain in the oceans threatened. Air pollution would increase.

If all production of ozone-destroying chemicals ceased today, those already released into the atmosphere would raise the level of chlorine in the stratosphere to 4.2 ppb — seven times the natural level. As production continues, the consequences are unpredictable.

LEFT: these graphic images of ozone levels over Antarctica say more than words ever could about the growing hole in Earth's protective ozone layer. Both images were taken with the Total Ozone Mapping Spectrometer (TOMS) on NASA's Nimbus 7 satellite; the top one in October 1979 and the one below in October 1987. Ozone levels decrease from green through yellow to purple. The hole was bigger in 1985 and 1987 than it was in 1986 and 1988, and did not centre over the pole in 1988 as it did in 1985 and 1987, when it covered nearly the entire Antarctic continent. But while its growth and movement year by year may be somewhat erratic, these images illustrate that, over a 10-year period, the hole has grown enormously.



Mercury

Obtaining the first closeup views of Mercury was the primary objective of the Mariner 10 space probe, launched from Kennedy Space Center in November 1973. After a journey of nearly five months, which included a flyby of Venus, the spacecraft passed within 805 kilometres of the solar system's innermost planet on 29 March 1974.

The photographs Mariner 10 radioed back to Earth revealed an ancient, heavily cratered surface on Mercury, closely resembling our own moon. The pictures also showed huge cliffs crisscrossing the planet. These apparently were created when Mercury's interior cooled and shrank, compressing the planet's crust. The cliffs are as high as two kms and as long as 1500 kms.

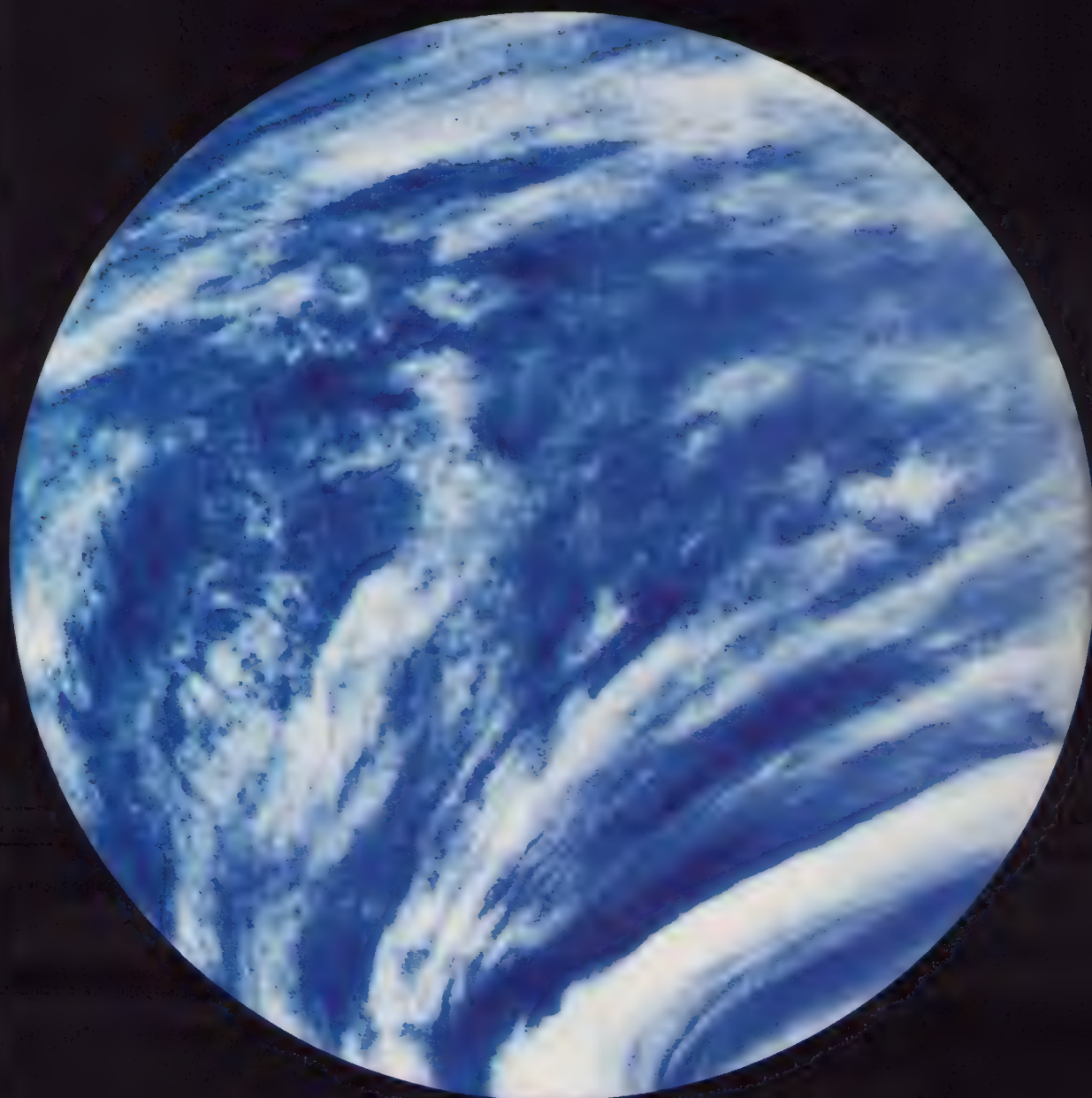
Mercury has a weak magnetic field and a trace of atmosphere that is a trillionth the density of the Earth's and composed chiefly of argon, neon and helium. The spacecraft reported temperatures ranging from 510°C on Mercury's sunlit side to minus 210°C on the dark side. Mercury literally bakes in daylight and freezes at night.

The days and nights are long on Mercury. It takes 59 Earth days for Mercury to make a single rotation. It spins at a rate of about 10 kms per hour, measured at the equator, compared to Earth's spin rate of about 1600 kms per hour at the equator.

Mercury, like Earth, appears to have a crust of light silicate rock. Scientists believe it has a heavy iron-rich core that makes up about half of its volume.

Mariner 10 made two additional flybys of Mercury — on 21 September 1974 and 16 March 1975 — before control gas used to orient the spacecraft was exhausted and the mission concluded. Until the Mariner 10 probe, little was known about Mercury. Even the best telescopic views from Earth showed Mercury as an indistinct object lacking any surface detail. The planet is so close to the Sun that it is usually lost in the Sun's glare. When it is visible on Earth's horizon, just after sunset or before dawn, it is obscured by the haze and dust in our atmosphere. Only radar telescopes gave any hint of Mercury's surface conditions prior to the voyage of Mariner 10.





The Venus clouds as viewed from above the North pole by the Jet Propulsion Laboratory's infrared radiometer experiment on the Pioneer Venus orbiter. The north pole is at the centre, and the subsolar point (local noon) is at the right-hand edge. The diffuse red disk represents the extent of the planet, not all of which was covered on this day (February 11, 1979) because of the orbital geometry. The image shows a bank of dense, cold cloud in a roughly crescent-shaped pattern around the pole. A tendency towards the formation of 'spiral arms' in the cloud can be seen. This polar collar cloud is 1000 miles across at its widest part and rises 10 miles above the main cloud deck. Its coldest part stays in a constant position with respect to the Sun, implying that it is produced by a disturbance caused by solar heating. The two bright features straddling the pole are probably caused by rapidly descending motion which clears the cloud away and exposes the warm atmosphere beneath. The 'eyes' rotate around the pole, completing one revolution every two and a half Earth days. Some theories of the Venus circulation would have predicted a single hot region at the pole. This complex double, rotating structure is surprising and has no explanation at present.

Veiled by dense cloud cover, our nearest neighbouring planet was the earliest subject of interplanetary explorations.

NASA's Mariner 2 passed within 34,762 kilometres of Venus in December 1962 and became the first spacecraft to scan another planet. Mariner 5, launched in June 1967, flew much closer, passing within 4,023 kms of Venus.

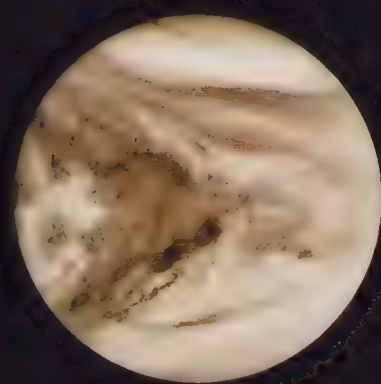
On its way to Mercury, Mariner 10 flew by Venus and returned ultraviolet pictures showing cloud circulation patterns in the Venusian atmosphere.

In the spring and summer of 1978, two spacecraft were launched to unravel the mystery of Venus. On December 4, the Pioneer Venus Orbiter was placed in orbit around the planet. Five days later, the five separate components which had made up the second spacecraft — the Pioneer Venus Multiprobe — entered the Venusian atmosphere. Venus resembles Earth in size, physical composition and density more than any other known planet. Approximately 97 per cent of Venus's atmosphere, about a hundred times as dense as Earth's, is carbon dioxide. (The principal constituent of Earth's atmosphere is nitrogen.) Venus's atmosphere acts like a greenhouse, permitting solar radiation to reach the surface, but trapping the heat which would ordinarily be radiated back into space. As a result, surface temperatures are 482°C, hot enough to melt lead.

Radar aboard the Pioneer Venus Orbiter provided a means of seeing through Venus's dense cloud cover and determining surface features over much of the planet. Among these are two continent-like highland areas. One, about half the size of Africa, is located in the equatorial region. The other, about the size of Australia, is to the north.

There is evidence of two major active volcanic areas, one larger than the Earth's Hawaii-Midway volcanic chain (Earth's largest), with a mountain higher than Everest. The concentration of lightning over these two regions suggests frequent volcanic activity at both places, making Venus the third solar system body known to be volcanically active — the others are Earth and the Jovian satellite Io.

Venus's predominant weather pattern is a high speed circulation of clouds made up of sulphuric acid travelling up to 362 kms per hour. The Pioneer Venus Orbiter continues to circle the planet. It is expected to send data about Venus to Earth for years to come.



In August and September 1975, two Viking spacecraft were launched from Kennedy Space Center, Florida, on a mission designed to answer several questions, including: is there life on Mars? The results sent back by the two unmanned laboratories, which soft-landed on the planet, were teasingly inconclusive. We still don't know whether life exists on Mars. While some of the tests of the red Martian soil indicated that biological activities were occurring, the same results could be explained by the planet's soil chemistry. No organic molecules were detected.

Mariner 4 flew past Mars on 14 July 1965 and approached to within 9,656 kilometres of the surface. It found no evidence of artificial canals or flowing water. Mariners 6 and 7 followed during the summer of 1969, returning about 200 pictures showing a diversity of surface formations.

On November 1971, Mariner 9 arrived, only to find Mars in the midst of a planet-wide dust storm. After the storm cleared, Mariner 9 beamed back pictures which revealed evidence that rivers, and possibly seas, could have once existed on the planet.

Photos sent from the Plain of Chryse, where Viking 1 landed on 20 July 1976, show a bleak, rusty red landscape. A panorama returned by the robot explorer pictures a gently rolling plain, littered with rocks and graced by rippled sand dunes.

Fine red dust from the Martian soil gives the sky a pinkish hue. Viking 2 landed on the Plain of Utopia. The landscape viewed was similar, but without dunes.

Both Viking landers became weather stations, recording wind velocity and direction, temperature and atmospheric pressure.

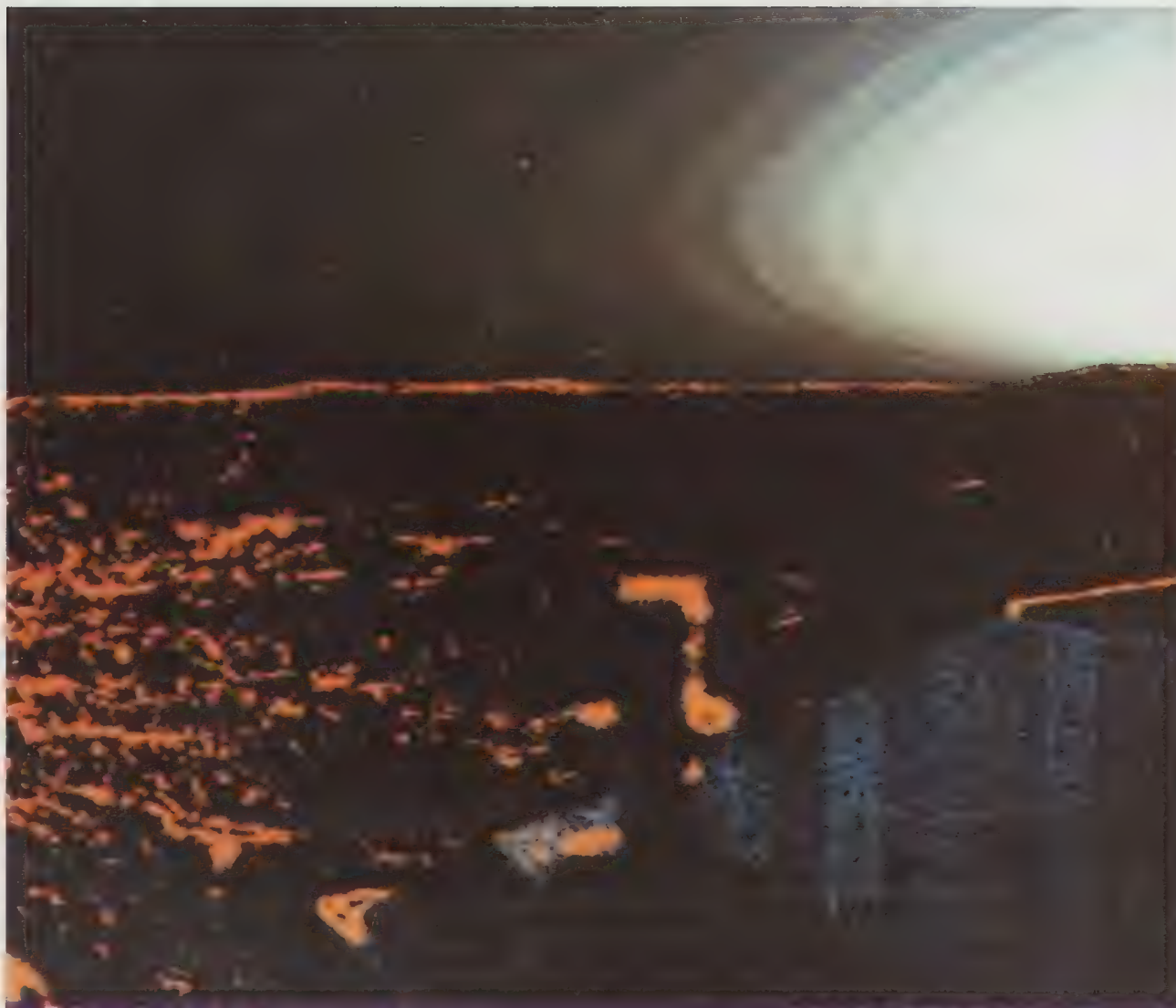
As days became weeks, the Martian weather changed little. The highest atmospheric temperature recorded was minus 21°C in midsummer. The lowest temperature was minus 124°C in winter.

Wind speeds near hurricane force were measured at both stations during global dust storms.

The Martian atmosphere, like that of Venus, is primarily carbon dioxide. Present in small percentages are nitrogen, oxygen and argon, with trace amounts of krypton and xenon.

Martian air contains only about one thousandth as much water as Earth's, but even this small amount can condense and form clouds which ride high in the atmosphere, or swirl around the slopes of towering Martian volcanoes. Local patches of early morning fog can form in valleys.

Mars has two small, irregularly shaped moons, Phobos and Deimos, with ancient, cratered surfaces.



Martian sunset, Viking 1.



Jupiter

The largest of the solar system's planets, Jupiter rotates once every nine hours, 55 minutes and 30 seconds. It takes the massive planet almost 12 Earth years to complete a journey around the Sun.

Jupiter is something of a mini solar system, with 16 known moons orbiting above its clouds.

In March 1972, NASA dispatched the first of four space probes to survey the colossal worlds of gas and their moons of rock and ice that lie outward from Mars and beyond the Asteroid Belt.

For each probe, Jupiter was the first port of call.

Pioneer 10, which lifted off in March 1972, was the first spacecraft to penetrate the Asteroid Belt and travel to the outer regions of the solar system. In December 1973 it returned the first closeup pictures of Jupiter as it flew within 132,252 kilometres of the planet's banded cloud tops.

Pioneer 11 followed a year later. Voyagers 1 and 2 were launched in the summer of 1977 and returned spectacular photographs of Jupiter and its 16 satellites during flybys in 1979.

These spacecraft found Jupiter to be a whirling ball of liquid hydrogen, topped with a uniquely colourful atmosphere which is mostly hydrogen and helium. It contains small amounts of methane, ammonia, ethane, acetylene, phosphene, germanium tetrahydride and possible hydrogen cyanide.

Jupiter's clouds also contain ammonia and water crystals.

Scientists believe it likely that between the planet's frigid cloud tops and the warmer hydrogen ocean that lies below, there are regions where methane, ammonia, water and other gases could react to form organic molecules. Because of Jupiter's atmospheric dynamics, however, these organic compounds, if they exist, are probably short lived.

The Great Red Spot has been observed for centuries through Earth-based telescopes. It is a tremendous atmospheric storm, similar to Earth's hurricanes, which rotates counterclockwise.

The space probes detected lightning in Jupiter's upper atmosphere and observed auroral emissions similar to Earth's northern lights in the Jovian polar regions.

Voyager 1 returned the first evidence of a ring encircling Jupiter. Photographs showed a narrow ring too faint to be seen by Earth's telescopes.

Saturn

No planet in the solar system is adorned like Saturn. Its exquisite ring system is unrivalled.

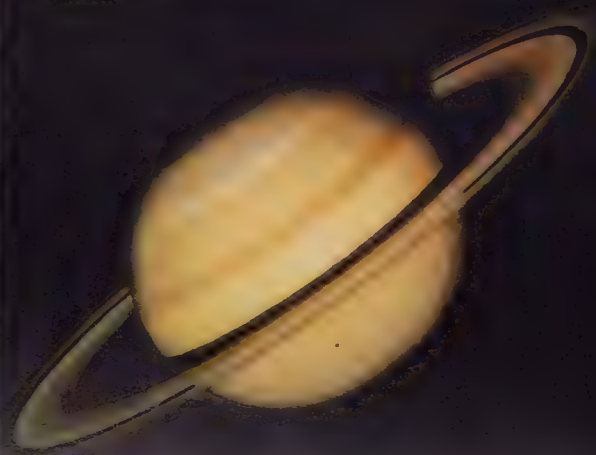
Like Jupiter, Saturn is composed mostly of hydrogen. But in contrast to the vivid colours and wild turbulence found in Jupiter's clouds, Saturn has a more subtle, butter-scotch hue and its markings are often muted by high altitude haze. Three American spacecraft have visited Saturn. Pioneer 11 zipped by the planet and its moon Titan in 1979, returning the first closeup pictures. Voyager 1 followed in November 1980, sending back photographs that revealed for the first time the complexities of Saturn's ring system and moons. Voyager 2 flew by the planet in August 1981.

The spacecraft discovered that there are actually thousands of ringlets encircling Saturn. Saturn's rings are composed of countless low-density particles orbiting individually around the equator at progressive distances from the planet's cloud tops. Analysis of radio waves passing through the rings showed that the particles vary widely in size, ranging from dust to boulders. Most of the material is ice and frosted rock.

Scientists believe the rings resulted either from a moon or a passing body which ventured too close to Saturn and was torn apart by great tidal forces; or the incomplete coalescence of primordial planetary material; or from collisions with larger objects orbiting the planet. Unable to form either into a moon or to drift away from each other, individual ring particles appear to be held in place by the gravitational pulls of Saturn and its satellites.

Radio emissions quite similar to the static heard on an AM car radio during an electrical storm were detected by the Voyager spacecraft. These emissions are typical of lightning, but are believed to be coming from the planet's ring system rather than its atmosphere. No lightning was observed in Saturn's atmosphere, but the Voyager spacecraft did see a version of Earth's northern and southern lights near Saturn's poles.

The probes also studied Saturn's moons, detected undiscovered moons, found some that shared the same orbit, and determined that Titan has a nitrogen-based atmosphere.





The six-hour flyby of Voyager 2 revealed more information about Uranus and its retinue of icy moons than had been gleaned from ground observations since its discovery over two centuries ago by the English astronomer William Herschel.

Uranus, the third largest of the planets, is the odd-ball of the solar system.

Unlike the other planets, it lies tipped on its side with its north and south poles alternately facing the Sun during its 84-year swing around the solar system. During Voyager's flyby, the south pole faced the Sun.

Voyager found that the planet's magnetic field does not follow the usual north-south axis found on the other planets. Instead, it is tilted at 60 degrees, and offset from the planet's centre, a phenomenon that on Earth would be like having one magnetic pole in New York and the other in Jakarta. Uranus's atmosphere consists mainly of hydrogen, with about 12 per cent helium and small amounts of ammonia, methane and water vapour.

Wind speeds range up to 200 metres per second, and blow from the west instead of the east as previously expected. Temperatures near the cloud tops measure minus 200°C.

The sunlit south pole is shrouded in a kind of photochemical "smog" believed to be a combination of acetylene, ethane and other sunlight-generated chemicals. Surrounding the planet's atmosphere and extending thousands of kilometres into space is a mysterious ultraviolet sheen called an "electroglow".

About 8,000 kms below Uranus's cloud tops there is thought to be a scalding ocean of water and dissolved ammonia some 10,000 kms deep. Beneath this ocean is an earth-sized molten core of heavier materials.

Voyager discovered 10 new moons orbiting Uranus, each about 40 to 170 kms in diameter. The planet's five known moons — Titania, Ariel, Miranda, Umbriel and Oberon — range in size from 480 to 1,600 kms across. The half-ice, half-rock spheres are a geological showcase, featuring 12 mile-high mountains, jagged cliffs and canyons, crater-pocked plains and winding valleys possibly carved out by glaciers.

The planet was thought to have nine dark rings; Voyager found 11. In contrast to Saturn's rings, which are composed mostly of bright grain-sized particles, Uranus's rings are made up of boulder-sized chunks.

Neptune is the smallest of our solar system's giant gaseous planets. Even so, with an equatorial diameter of 49,250 kilometres, Neptune's volume could hold 57.5 Earths.

The planet orbits the Sun once in 165 years.

Voyager 2 was the first spacecraft to visit Neptune when it flew within 5,000 kms of the planet's north pole on 25 August 1989. The spacecraft was one of a twin pair launched in 1977 to explore the outer planets. Voyager 1 flew past Jupiter (1979) and Saturn (1980); in addition to Neptune, Voyager 2 visited Jupiter (1979), Saturn (1981) and Uranus (1986).

Neptune is now known to have eight moons, six of which were found by Voyager. The length of the Neptunian day is 16 hours, 6.7 minutes.

The new moons found are all small and remain close to Neptune's equatorial plane. Names selected from mythology's water deities are to be given by the International Astronomical Union. Even though Neptune receives only three per cent as much sunlight as Jupiter, it is a dynamic planet, recording the strongest winds measured anywhere in the solar system. Most of the Neptunian winds blow westward, opposite to the rotation of the planet.

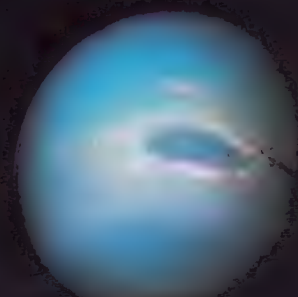
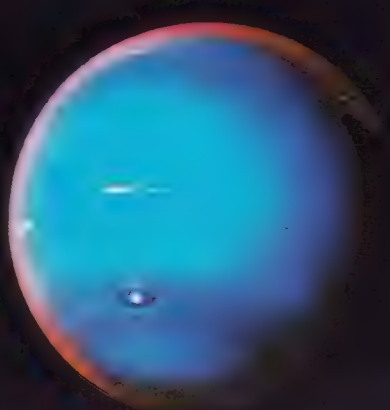
Neptune's atmosphere is primarily hydrogen, helium and methane. It is the methane which gives the planet its blue colour.

Neptune also has a large internal heat source, as the planet emits nearly three times as much heat as it receives from the Sun.

Voyager 2's flyby revealed several large, dark spots reminiscent of Jupiter's hurricane-like storms. The largest spot, dubbed the Great Dark Spot, is about the size of Earth and is similar to the Great Red Spot on Jupiter. Near the Great Dark Spot, winds blow up to 2,000 kms per hour. A small, irregularly shaped, eastward-moving cloud was observed "scooting" around Neptune every 16 hours; this could be a cloud plume rising above a deeper cloud deck.

The magnetic field of Neptune, like that of Uranus, turned out to be highly tilted — 47 degrees from the rotation axis, and offset at least 13,500 kms from the physical centre. Scientists think that the extreme orientation may be characteristic of flows in the interior of Neptune.

Voyager 2 solved many of the questions scientists had about Neptune's rings. Searches for "ring arcs", or partial rings, showed that Neptune's four rings actually are complete, but are so diffuse, and the material in them so fine, that they could not be fully resolved from Earth.



Pluto is another planetary odd-ball, a strange world that has baffled scientists since it was first sighted in 1930.

It is not the large gas giant you would expect to find in the outer reaches of the solar system.

Instead, Pluto is a small world, little more than a celestial snowball. Its diameter is around 3,000 kilometres, about the same as Earth's moon. Observations indicate that its surface is covered with methane ice.

It is the most distant of the planets, yet the eccentricity of its orbit periodically carries it inside that of Neptune's. The orbit is also highly inclined — well above and below the orbital plane of the other planets. It takes about 248 years for Pluto to complete one orbit around the Sun, but the orbit is so elongated that it actually spends about 20 years of its time inside the orbit of Neptune. (In fact, Pluto is inside Neptune's orbit now, and will be until 1999, so that Neptune is temporarily the furthest planet from the Sun.)

Our understanding of Pluto has changed greatly in the past few years, as a result of analysis of new ground and space observations.

The planet appears to be composed of rock and ice and have a bright layer of frozen methane on its surface.

Pluto's moon, Charon, was discovered in 1978. Charon is more than half the size of Pluto itself, so large by comparison that Charon and Pluto could be said to form a unique double planet.

At 9.6 billion kms from the Sun, Pluto is simply too far away for current spacecraft to reach in a reasonable length of time.

It will be many years before any machines or humans see Pluto up close, dimly lit by a Sun so distant that it seems like just a rather bright star in the blackness of space.



PLANETARY DATA	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Mean distance from Sun (millions of kilometres)	57.9	108.2	149.6	227.9	778.3	1,427	2,870	4,497	5,900
Period of revolution around the Sun	88 days	224.7 days	365 days	687 days	11.86 years	29.46 years	84 years	165 years	248 years
Rotation Period	59 days Retrograde	243 days 56 minutes	23 hours 37 minutes	24 hours 55 minutes	9 hours 40 minutes	10 hours Retrograde	17 hours 12 minutes	16 hours 6 minutes	6 days 9 hours Retrograde
Eccentricity of orbit	.206	.007	.017	.093	.048	.056	.047	.009	.254
Equatorial diameter (kilometres)	4,880	12,100	14,756	6,794	143,200	120,000	51,800	49,250	3,000-3,500

Source: all information on the planets from NASA.

SUPERANNUATION: WHAT YOU NEED TO KNOW

REMEMBER that superannuation is simply savings that receive large tax concessions. What makes super especially attractive is that the employer puts in money that would not otherwise be paid as salary.

Superannuation next century will most likely be paid as a private pension, not a lump sum. That is in order to reduce reliance on the age pension. It is also the standard practice in comparable countries. So if you want a lump sum, you will probably have to provide for it outside superannuation.

Your best investment is to pay off consumer debt and the home mortgage. Even the tax advantages of superannuation do not compensate for the high after-tax cost of the interest on such loans.

When changing jobs, always roll over the termination payment into an Approved Deposit Fund or a Deferred Annuity, even if you want to cash it in later. You will still save a lot of tax. But shop around for rollover funds with low fees, especially entry and exit fees.

Very generous tax concessions become available to the self-employed and those without employer superannuation in the 1990-91 financial year. There will also be many new personal superannuation products provided by the institutions, which could be very interesting.

Remember that there are limits on what you can put into and take out of superannuation, and bear in mind also that it can be difficult to get access to superannuation savings before retirement. Keep it in perspective.

THIS IS YOUR MONEY. So the question of how the \$600 billion likely to accumulate in super funds by the end of the decade will be invested, will be of increasing interest to the community.

Superannuation funds will be a major source of finance for the restructuring of Australian industry. Later, it is reasonable to expect that they will be prime players in helping to buy back the farm.

Much public concern about foreign investment in Australia overlooks the fact that, in the future, with savings to do so, foreign ownership can be bought out by Australians. Foreign investment is not a tide that will never recede.

An area of general social relevance is the economic power that large institutions will have as the guardians and investors of superannuation savings. While the pool of savings grows to \$600 billion, the institutions holding the money will decrease in number. The shake-out has already started. Small funds will find it generally harder to compete.

A handful of fund managers will have unprecedented economic power. Should they be constrained in the public interest? Perhaps it is not necessary. After all, governments make the rules on tax incentives. When they change those incentives, the funds have little choice but to follow, or fall behind in their investment returns. For the funds, competitive returns are the name of the game.

That goes too for the union funds, whose power, contrary to some popular views, will not be anything like so great as to dictate the investment of superannuation savings.

It is likely that the investment policies of superannuation funds will attract increasing public scrutiny — on environmental and social grounds, for instance.

From a purely financial perspective, a project with environmental problems is riskier than one without. So it comes as no surprise that at least one major Australian bank already insists on environmental audits before it will lend money for large projects. The environment will be a factor in superannuation funds investment decisions.

It is clear that the direction of public opinion, both in Australia and overseas, is that investment returns are far from the only name of the game. The easiest way to ensure that funds are susceptible to public opinion is to expose them to it. And the way governments can do that is through insisting on disclosure by the funds of their policies and the full details of their investments.

No government is likely to tell the institutions what to

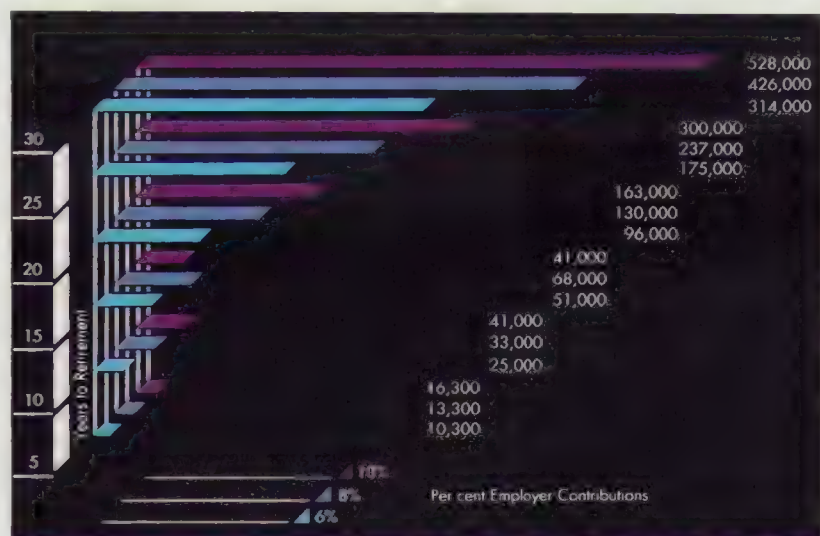
Australia's superannuation savings will total \$600 billion by the turn of the century, according to Federal Treasury estimates. That is more than enough to pay off half the trade deficit — of the United States! It would put Australia's external account into the black several times over. BARRY MARTYN reports on the implications of this new financial giant.

do with these massive funds. But there will be incentives. There is a sizeable benefit in investing in Australian companies. A fund that does so receives a significant tax bonus,

unavailable from any overseas investments.

Spare a thought for fund managers of the future. First rate financial skills will be as necessary as ever, but not sufficient. They will have to be accompanied by keen social and political perceptions, as well as an ability to communicate sensitively and effectively with the community at large. For some of our financial institutions, it could be a steep, painful and even expensive learning curve.

6 per cent and after: The end benefit an average worker on \$500 per week will get, not only under the expected 6 per cent super award, but later.



Source: Jacques Martin Pty Ltd

2000

INDUSTRIAL FUNDS
\$30 BILLION

OTHER FUNDS
\$570 BILLION

1990

INDUSTRIAL FUNDS
\$2.2 BILLION

OTHER FUNDS
\$100 BILLION

Growth of super funds: share of total money under management administered by superannuation funds, now and at the end of the decade.

Source: Jacques Martin Pty Ltd

BARRY MARTYN is a finance consultant

**The brutal crushing of
democratic aspirations
in Tiananmen Square
sent shock waves
through Hong Kong,
prompting more than
1000 Hong Kongers a
week to flee the pros-
pect of 1997, when
Britain hands back its
colony to China. ERIC
ELLIS examines Hong
Kong's prospects as
the capitalist flame to
China's dragon, and
the ramifications this
will have for Taiwan.**

I have the army behind me
Deng Xiaoping

But I have the people behind me
Zhao Zhiyang

AN ANGRY EXCHANGE between Chinese strongman Deng Xiaoping and his one-time protege, the now disgraced former general secretary of the Chinese Communist Party, Zhao Zhiyang, on May 17, 1989, two weeks before the tragic Tiananmen massacre.

It is easy to understand why more than 1000 panic-stricken, prosperous Hong Kongers, the "yacht people" as they are known, are fleeing Hong Kong each week, armed with the bizarre passports of Belize, Costa Rica or Tonga. Look no further than Deng's brutal crushing of China's short-lived pro-democracy movement.

If Tiananmen shattered Hong Kong's already fragile confidence in the future, the willing acquiescence of its British colonial rulers to China has left permanent scars.

The same United Kingdom that 1000 Hong Kongers helped by dodging Argentine bullets in 1982, has sold them out eight years later. Lest it offend the nascent superpower, Britain has failed to guarantee rights for Hong Kong people after 1997 — rights enshrined in the 1984 Sino-British Joint Declaration under which Britain agreed to give up 156 years of colonialism — apart from promising to register "strong and significant protest" if China reneges on its promises.

London backed away from pressing to install democracy by way of free elections before 1997 and has effectively rendered the population stateless by refusing to grant British residency to all except 225,000 elite of a total population of 5.8 million.

To gauge some idea of Hong Kong's prospects, it is important to note the cultural and political factors that shape this remarkable place. Firstly it must be remembered that 90 per cent of its population either was an immigrant, or is descended from one, be it British or Australian tax exiles or, as is the vast majority, mainland Chinese drawn to those bright lights and skyscrapers across the Guangdong paddyfields. All have made good in Hong Kong.

香港

1997

ACQUIESCE OR EMIGRATE

WHILE NEWS of the brain drain has made headlines in Hong Kong so often recently, those who can leave the territory between now and 1997 will be less than a million, probably around half a million.

In other words, about five million people will have to stay in Hong Kong. From the local community's point of view, the Sino-British Joint Declaration must be acknowledged as binding, the British administration in the transitional period must be supported, and contacts with the Chinese authorities must be maintained at all levels.

The present Chinese leadership's attitude is to maintain the open door policy and the reforms in the economic arena, while pursuing a conservative Leninist line politically. The deteriorating economic situation in China, and the shortage of foreign exchange, will prompt the Chinese leadership to treat the maintenance of Hong Kong's stability and prosperity seriously.

At the same time, the sense of insecurity on the part of the Chinese Communist regime in the aftermath of mass protests, and the impact of the local mass media inside China in the past years, will most likely cause Beijing to strengthen its control of and interference in Hong Kong.

This implies that the freedoms which Hong Kong people will continue to enjoy will be those restricted to dancing and horse-racing. Hence, while Hong Kong people may have a reasonable chance of maintaining their existing living standards, their freedoms, human rights and the rule of law will probably be considerably eroded. The options are whether to acquiesce or emigrate. Unfortunately, almost five million people do not have the choice.

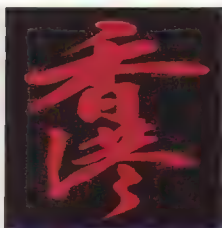
Most Hong Kong people expect a period of major chaos in China after Deng Xiaoping's death, and whether or not Hong Kong can survive this crisis is not known.

It is difficult to speculate about the impact on Hong Kong of the future leadership succession in China, but some observations may be made.

The new leaders will appreciate that the legitimacy of the regime will depend on its ability to improve the living standards of the people, and they therefore will continue to value Hong Kong's contributions to China's modernisation. They will be eager to attract capital and management know-how from the territory. A vast majority of the middle and lower-level cadres below 60 years old clearly want further economic reforms and convergence with capitalism. The second generation leaders in China, whoever they may be, will lack the charisma and status to resist the trend. They too will have to accommodate to the demands for political reforms articulated by the intelligentsia emboldened by the changes in the leadership. Chaos and unrest, unfortunately, may well be commonplace. Corruption and privileges will tend to worsen, and they will generate much dissatisfaction among the intellectuals and the people and may contribute to a revolutionary situation.

In sum, Hong Kong's business community will find China a more attractive market and option for investment. Competition among the coastal provinces will bring about better terms for the territory's businessmen. The latter, however, will have to take into consideration the cost of corruption and the risk of political instability.

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Secondly, the treaty under which the British signed away Hong Kong was ratified during 1984-85 without consultation with Hong Kong's people and at the urging of a China seducing Thatcher's Britain and the international community with its promises of economic reform. The political landscape is now dramatically different.

In Britain, the fate of Hong Kong has finally become a front page issue; at the same time Margaret Thatcher is adopting a bunker-like attitude to British foreign policy. She faces the prospect of a Conservative Party split on Britain's policy towards Europe, which could be precipitated by increasing backbench agitation over

Singapore and Hong Kong.

Culturally, China's Cantonese-speaking south and the predominantly Mandarin-speaking north are extremely diverse. The two regions share a vigorous distrust of each other.

With imperial and governmental power historically centred north of the Yangtze, the south has always seen Beijing as slow and cumbersome, bureaucratic meddlers preventing them from getting on with the business at hand. The north in turn regard the Cantonese as mercenary, almost philistine, who put personal interests before those of Mother China. Distrust breeds contempt and in Hong Kong it manifests itself through a refusal — unless forced — to speak, or even learn, Mandarin.

The Taiwanese pose a different set of circumstances for Hong Kong. Spend the first fortnight of any October among the backstreets and grubby tenements of Hong

WALTZING WITH THE DRAGON

MARTIN LEE CHU MING

An anglicised Queen's Counsel, Lee has devoted more time in recent years to politics than he has to practising law. Easily Hong Kong's best-known politician and leading liberal, he was recently accorded a 74 per cent popularity rating, and was judged in a newspaper poll the man most Hong Kongers would like to see as their first chief executive after 1997.

Lee has been the most outspoken critic of both Chinese and British policy and action in Hong Kong, particularly since the Tiananmen crackdown. He helped found the vocal umbrella lobby Hong Kong Alliance in Support of the Patriotic Democratic Movement in China, which Beijing has accused of "subversion".

In November last year Lee and outspoken liberal ally Szeto Wah were expelled by Beijing from the Basic Law Drafting Committee, the body of overwhelmingly Chinese officials formulating the mini-constitution that will apply in Hong Kong after 1997.

DOUGLAS HURD

British Foreign Secretary and loyal Thatcherite, Hurd is the man entrusted with dictating British policy over Hong Kong in the twilight of its colonialism. However inconclusive, the recent concessions on speedier democratisation and the granting of British nationality to 225,000 select Hong Kong residents has shown Hurd more willing to stand up to the Chinese in negotiations than his predecessor, Sir Geoffrey Howe. In an earlier incarnation as erstwhile author, Hurd penned the breathless *The Smile on the Face of the Tiger*, an "airport bookshop thriller" centred around a nuclear face-off between China and Britain over Britain's occupation of Hong Kong. The novel, published in 1969 at the height of the Cold War, drew heavily on Hurd's experiences as a diplomat in Beijing in the mid-1950s. Revealingly, it contains the passage, uttered by Hurd's central character, "If one thing is clear from Chinese history, imperial, nationalist or communist, it is that they never cared a damn for world opinion."

DENG XIAOPING

Unequivocally China's supreme decision-maker, Long March veteran Deng is the great survivor of Chinese politics. Purged twice during Mao's Cultural Revolution when he was dubbed a "capitalist roadster" and accused of "poisonous activities against the state and the party", he has effectively led the country since his rehabilitation in 1981. He has been the principal architect of China's open-door economic reforms while leaning his country heavily towards closer economic and political relations with the West, in particular the US and Japan. While often romanticised in the West as a cuddly grandfather, Deng was also the co-architect, with long-time political and military ally President Yang Shangkun, of the crackdown against pro-democracy demonstrators last year. Now 85, Deng considers the recovery of Chinese sovereignty over Hong Kong as "leading the list of my sacred tasks".

ZHOU NAN

China's former Vice Foreign Minister, 62-year-old Zhou was recently appointed the Hong Kong-based head of the New China News Agency, widely considered China's shadow government of the colony.

Known as an uncompromising technocrat with a long history of dealing with Britain (he headed the Chinese negotiating team in 1984), Zhou replaced the liberal and well-liked Xu Jiatun, who led the mission from 1983, frequently lauding the virtues of capitalism. No such concession is expected from hardliner Zhou, who has described the Sino-British Joint Declaration as "a bundle of papers" that though important, would always be peripheral to China's interests.

Hong Kong. London has been on a campaign to pressure Western nations, particularly Australia, into accepting more Hong Kong people in the lead-up to 1997, thereby relieving some of its national shame.

Cultural and economic factors are also crucial in the Hong Kong conundrum. When Britain seized Hong Kong in 1841 they chose well. The local Cantonese are considered the most industrious of all Chinese and their entrepreneurial tail wagged the colonial dog, to make Hong Kong one of the most economically vibrant of all British colonies. The same factors are at work in China itself. Hong Kong interests provide more than a million jobs in Guangdong Province bordering the colony, tapping the same Cantonese drive that motors Hong Kong.

Guangdong is the engine driving the greater Chinese economy, effectively a fifth "little dragon", to use the term coined by economists to describe Asia's four newly industrialised economies: Taiwan, South Korea,

Kong and you will soon get a fair idea of where Hong Kong's political sympathies lie.

On October 1, the commemoration of Mao Tse-tung's proclamation of the communist People's Republic of China in 1949, the only PRC flags flying are visible, as always, from atop the headquarters of the New China News Agency (NCNA) and the Bank of China. Nine days later, the Double Tenth celebrating the Kuomintang's 1911 proclamation of the Republic of China (ROC), thousands of Taiwanese flags flutter proudly and loudly from flats, offices, schools, temples and construction sites.

This support comes not from the administrative mandarins reclining on leather armchairs along Lower Albert Road, Hong Kong's equivalent to Whitehall, but from ordinary Hong Kongers lacking the money, privilege and contacts for a fast exit should Beijing renege on its post-1997 promises. It also offers a window on why an army of "journalists" representing the NCNA, China's

unofficial embassy in Hong Kong, daily ply the colony's lanes and markets "researching" information and peddling influence.

With both Chinas committed, albeit on their own terms, to the reunification of all Chinese territory, Hong Kong and, to a lesser extent, Macau are of paramount importance to China's intentions in its immediate theatre.

Few in the international community doubt Beijing's sincerity in maintaining the economic viability of Hong Kong after 1997. China has enshrined broad guarantees in the 1984 Sino-British Joint Declaration that it will maintain Hong Kong's present economic and social systems for 50 years beyond 1997. It is here that the importance of Hong Kong to Chinese intentions toward Taiwan, and equally Taiwan's toward the mainland, take on extra dimensions.

\$US75 billion, sitting in Taipei banks, Taiwan has none of the pressing economic concerns of the mainland in willing the successful integration of Hong Kong into China.

A particularly gloomy scenario perhaps, but in the harsh light of Tiananmen and China's increasing isolation since, hardly an unforeseeable one.

Taiwan already has an influential presence in Hong Kong. A de facto embassy, the Free China Centre, processes visas and peddles propaganda to fuel the large groundswell of support, remembering that 90 per cent of Hong Kong's population are actual, or descended from, immigrants fleeing Communist China's economic suppression.

Taiwan's business interests in Hong Kong extend across all sectors, but are particularly evident in media. Hong Kong's largest circulation newspaper, reaching

DON'T ROCK THE SAMPAN

THE IRONY of Hong Kong as it approaches 1997 is that most of the common features associated with decolonisation are present, but none are to be realised.

Martin Lee has all the style of a new, post-colonial leader, but he cannot play any role in determining Hong Kong's political future. The administration of Hong Kong, while controlled from Whitehall, is largely in the hands of local mandarins, without whose compliance colonial policy could not be implemented. But they, too, can only look forward to exchanging one outside authority for another, and the administration of Hong Kong is already largely subject to China's supervision.

A transitional form of representational government is in place, albeit with few powers and heavily weighted in favour of the establishment, and the demand for greater democracy is accelerating, but this trend will also be frustrated after 1997. There is a growing sense of social and cultural identity in a community whose only previous common interest was rejection of the mainland and making a profit. Like the other aspects of post-colonial society, that emerging identity will be over-ridden by China's national interest.

In effect, the people of Hong Kong will lose their colonial masters but will not gain self-determination. The British Governor will be replaced by a Chinese Governor and, so the theory goes, little else should change. It is a strange twist of history, therefore, which has transformed the simple issue of returning to China the territory once wrested from it by force of arms into a challenge to the British conscience and to British immigration policies.

Perhaps if Britain had begun to develop local democratic rights earlier, the picture would have been different. Perhaps China's ability, literally, to turn off the water at any moment, meant that was not an option. Britain has always had to tread a careful path between protecting local interests, not provoking Chinese action, and looking after Britain's long-term goals.

Clearly Britain can do little now to halt or change the process. The irony for Whitehall is that, while it limits the right of its colonial subjects to immigrate, the Portuguese have granted citizenship to theirs in Macau. Should they move to Portugal after Macau rejoins China, EEC rules will give them free access to Britain.

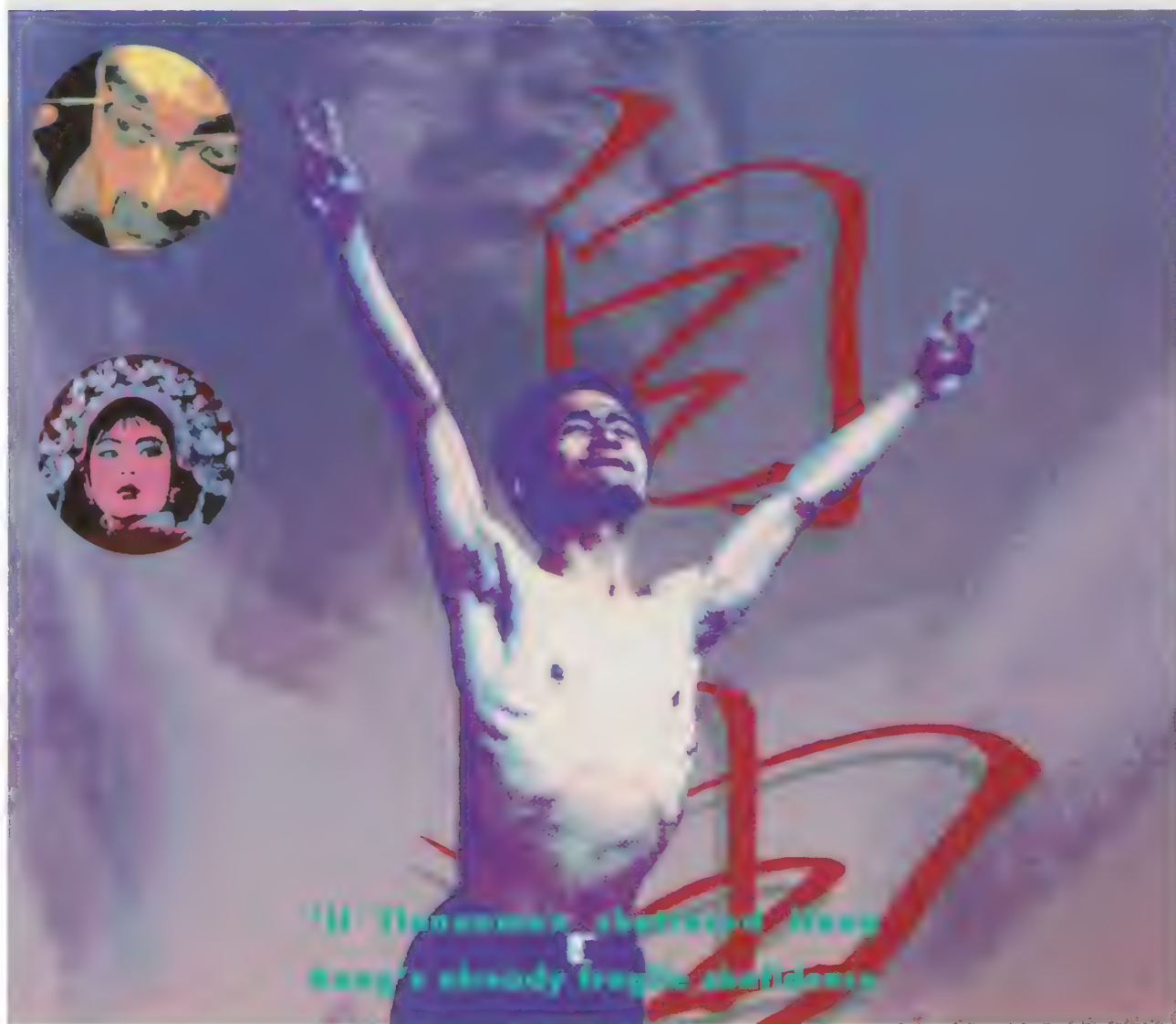
Ultimately, the issue is now one of the interaction between the people of Hong Kong and the government in Beijing. Foreign links with Hong Kong will play a role, including those of Taiwan, but it is inconceivable that Beijing could tolerate a Hong Kong used to undermine its position and policies. By the same token, however, Beijing will be anxious to preserve the economic benefits it derives from Hong Kong and from Hong Kong's position as its interface with the rest of the world.

The greatest irony is that Hong Kong's best prospects lie in continuing its laissez-faire economic success and its role as China's middleman. The more it succeeds, the harder it is for China to intervene. At the same time, Britain and the rest of the world would strive to make it work for fear of a new wave of "sampan people" to follow in the footsteps of the "yacht people" of today. The cost is that the people of Hong Kong will not be allowed to rock the post-colonial boat.

China's current policies and leaders won't last forever. If they can find the right strategy, the people of Hong Kong may yet have the opportunity to play a positive role in developing a modern China.

ANDREW WATSON

Head of Centre for Asian Studies,
University of Adelaide.



'If Tiananmen shocked Hong Kong's already fragile shell, then

in the future, the willing acquies-

cence of its British colonial rulers to

China has left permanent scars'

With its economic and hence, for the ruling communists, political future on the line, China is considered eager to use Hong Kong as its way of proving Deng's seemingly unworkable "one country, two systems" ideal is viable.

Beijing believes a successful Hong Kong, and Macau, would give it added currency when presenting Taiwan and the international community with as irresistible as possible an argument to press formal reunification on Taiwan. Beijing believes 50 years is a reasonable timetable for "convergence" of the two systems. Taiwan is as anxious for reunification — but on its terms. With the world's second highest foreign reserves to Japan,

one in three households, is the feisty Oriental Daily, controlled by Taiwan-based interests in Hong

Kong. Another print media power is Sally Aw's Sing Tao group, which while pragmatically softening the stridency of its line in recent years, has traditionally adopted a pro-Nationalist stance. Miss Aw until recently was noted in the Republic of China Yearbook as a "friend" of Taiwan.

Indeed, a much under-reported attempt in 1987 by Taiwanese interests to negotiate the purchase of one of Hong Kong's two television networks is believed to have been a significant factor in the sudden enactment of legislation precluding non-Hong Kong interests from

EMIGRATION SURGE

WITH A population of over five million, Hong Kong is one of the major cities of Asia, with a rapidly developing economy, a high standard of living and economic links with Singapore, China, Taiwan, Japan, the United States, Canada and Britain, as well as with Australia. It is a major banking and commercial centre, the headquarters of a major carrier (Cathay Pacific) and a tourist attraction based on its extensive and cheap shopping facilities. This strong economic position has made it a very important outlet and gateway for China. The arrangements after 1997 follow the principle "one country, two systems" which has also been offered to Taiwan. This attempts to maintain the economic role of Hong Kong by reassuring its people that political incorporation will not materially affect their position for the next 50 years. The Chinese hope that this reassurance will prevent a flight of capital, of entrepreneurs and of the educated.

As a Crown Colony, Hong Kong did not enjoy internal representative democracy. It is, however, undeniably capitalist and its citizens have enjoyed a fair degree of freedom of expression despite the absence of effective democratic institutions. Its population is overwhelmingly Chinese, with small European, Eurasian and Indian populations as well as immigrants from other parts of Southeast Asia. Thus it is unlikely to see the mass exodus of ethnic minorities which was experienced in some other British colonies such as Sri Lanka. The major elements likely to seek to emigrate from Hong Kong (and already doing so in significant numbers) include:

- Businessmen with connections elsewhere, such as Singapore, Taiwan, Canada, the United States, Britain and Australia. These are likely to benefit from immigration programs, such as those of Canada or Australia, which give special preference to entrepreneurs willing to transfer capital and to set up businesses. Considerable transfer of capital has already taken place, especially to other Pacific Rim areas such as British Columbia and California. In Australia, Sydney and Perth have been the most obviously affected by this trend. These businessmen are overwhelmingly Chinese and will seek to settle their families with them.

- Those who have served the colonial government, are proficient in English and reluctant to remain under a communist regime. The British government has extended passport rights to many of these and some will undoubtedly settle in England where most of the existing Chinese population derives from Hong Kong already. However, some will prefer other opportunities for suitable middle-class employment to be better than in England, or where they already have links with existing Chinese settlers.

- Those who, in the face of recent events in China, do not trust promises of human rights and free expression which, historically, have not been part of the mainstream Chinese political tradition before or after the communist victory of 1949. Most of these are likely to have been educated in tertiary institutions.

- Those who left China for Hong Kong as refugees from communism once before, comprising half the Hong Kong population 20 years ago and still an important element.

Most of those seeking to resettle from Hong Kong are likely to be well educated and/or economically successful. They are thus being sought by a number of countries for the transfer of their skills and resources. Canada has been particularly active, with recruiting officers from the national and the provincial level located in Hong Kong already. Australia has been much slower, perhaps because of the "Asian migration" debate of the 1980s, which has been much less important in North America outside British Columbia and California. Nevertheless, Hong Kong immigrants

controlling Hong Kong electronic media, a move which sat outside the colonial government's "non-intervention" policy for business. The legislation also backfired on Australian businessman Alan Bond who at the time owned

a large slice of the other network.

The progress Taiwan has made on democratisation in recent years has not gone unnoticed in Hong Kong, contemplating its own lack of franchise and its future under the communists. In his final testament before his death in January 1988, the father of modern Taiwan and son of Chiang Kai-shek, Chiang Ching-kuo, appealed for constitutional democracy for Taiwan and a continuing struggle for China's reunification.

Beginning with the July 1987 lifting of 38 years of martial law, the ruling Taiwanese Nationalists have progressively moved towards implementing democratic reforms.

Chiang's successor, Taiwan-born Lee Teng-hui, has steadily guided the island towards democracy. Last year's elections, the first boasting a semblance of freedom in Taiwan's history, were mostly trouble-free and saw a 40 per cent vote for opposition candidates. At the same time Taiwan has been stepping up its own unofficial presence in China and its courting of the world, both with the help of its enormous financial backing.

Barely a week after vigorously condemning the bloody June 4 crackdown in Tiananmen Square, direct dial telephone links were established between Taiwan and the mainland. Direct, official air and sea trade links are on the way.

Taiwan's businessmen are clearly outpacing their government in developing ties with China, as local entrepreneurs rush to invest on the mainland. Formosa Plastics, Taiwan's largest private company, recently revealed it was studying investment opportunities in China, advocating "the unification of China through a free economy". Beijing is responding by offering tax breaks and favourable treatment to new investors.

Economists estimate total investment by Taiwan businessmen in China at about US\$1 billion. Taiwan-China trade in 1989 totalled US\$3.7 billion, up from US\$2.7 billion in 1988 and more than double the 1987 total. Much of this investment is directed through Hong Kong.

'London has been on a campaign to pressure Western nations, particularly Australia, into accepting more Hong Kong people in the lead-up to 1997, thereby relieving some of its national shame'

1842 Brought under Chinese control. Britain establishes trading post in Guangzhou (Canton).

1839 Outbreak of the Opium Wars when China attempts to stamp out British opium imports. Manchu emperor runs British fleet out of Macao. Fleet moves to Hong Kong.

1840 British military and naval power forces China to the bargaining table.

1841 China cedes Hong Kong Island to Britain under the Convention of Chuenpi on 20 January. But the agreement is not ratified and hostilities resume until 29 August 1842, when the Treaty of Beijing recognizes the cession in perpetuity of the island to Britain.

1842 The Second Opium Wars conclude with the signing of the Convention of Peking, under which China cedes

to Britain part of Kowloon on the mainland opposite Hong Kong Island.

1860 The Second Convention of Peking extends Hong Kong's boundaries by granting Britain a 99-year lease on the New Territories.

1911 Qing Dynasty (Manchu Empire) overthrown in peasant uprising. Manchu supporters flee to Hong Kong, now a busy port.

1941 Japan attacks Hong Kong on 8 December. British surrender after fierce fighting on Christmas Day.

1946 Mass influx of Chinese immigrants pushes population from 600,000 to 1.8 million by the end of 1947.

1949 People's Republic of China formed after Mao's communist forces overthrow the nationalist government. Massive migration to

Hong Kong of hundreds of thousands of Chinese, mainly from Shanghai and other commercial centres.

1950 Restrictions imposed on immigration from mainland China, but large-scale illegal immigration continues.

1956 Spectacular economic expansion begins.

1967 Riots inspired by China's Cultural Revolution.

1975 "Boat people" begin arriving from Vietnam. Numbers peak in 1979 when 66,000 land.

1982 Talks begin with China over Hong Kong's future.

1984 Joint Sino-British Declaration on 19 December sets out the terms Britain to hand back Hong Kong

Island, Kowloon and the New Territories to China. After 1997, Hong Kong will become a "special administrative region" of China.

1986 About 8000 refugees from Indochina resettle in Hong Kong.

1987 Tens of thousands of Chinese rats join 30,000 emigrants.

1988 Hong Kong receives 45,800 following Tiananmen Square incidents.

1989 Emigration is 42,000, including a disproportionate number of well educated and professional people. Passport applications rise 72 percent.

1997 Britain to hand back Hong Kong Island, Kowloon and the New Territories to mainland Chinese control.

Continued page 63

Elsewhere in Asia, Taiwan's political and economic influence is developing even faster. Taiwan is now the second largest (only to Japan) investor in Indonesia, Malaysia and Thailand, where many of Asia's largest overseas Chinese population are the next generation descendants of Nationalist stalwarts who escaped south from Mao's 1949 revolution.

Taiwan has also made gradual but significant diplomatic progress, particularly in the Third World, an arena China skilfully exploited in bouncing the ROC from its United Nations seat in 1972. Employing a pragmatic approach aimed at "gradually expanding the scope of flexibility" while waving \$US bills, Taiwan now boasts diplomatic relations with 26 (at the time of writing) countries.

Taiwan is the Philippines' largest investor and, dangling the carrot of further aid to ASEAN's poorest member, is actively lobbying and tempting Manila into transferring its diplomatic loyalties from Beijing. Taiwan has also been quick to read Europe's political winds, expanding unofficial ties with the European Community ahead of 1992, while waving aid and trade concessions to East European nations like Hungary, Czechoslovakia, Poland, even the Soviet Union. By contrast, China has condemned such nations.

Simultaneously, the Republic of China is also pushing its claims to join major international bodies, such as GATT (the General Agreement on Tariffs and Trade), the OECD and aid agencies such as the World Bank, the International Monetary Fund and the International Bank for Reconstruction and Development.

The true impact of Taiwan's influence in Hong Kong is still to be realised.

ERIC ELLIS is a senior journalist with *The Sydney Morning Herald* and was that paper's Hong Kong-based correspondent from 1985-88.

already form a major element in the Australian intake.

While capital transfer from Hong Kong to Australia will undoubtedly occur, it is hard to predict how extensive this will be or what its long-term impact might be. Much Hong Kong investment in Canada and Australia is in real estate and is designed to establish a claim to settle while at the same time owning an asset from which it would be easy to withdraw funds. However, immigration on a considerable scale is highly probable. Hong Kong, as a birthplace, sent 3296 migrants to Australia in 1984-85; 3117 in 1985-86; 5577 in 1987-88; and 7298 in 1988-89. This made it the fifth largest source during that period, after Britain, New Zealand, Vietnam and the Philippines, although only slightly ahead of Malaysia.

The impact on the business migration program is much more marked. Between July and December 1989, 3241 visas were issued to applicants from Hong Kong under the Business Migration Program, out of a total of 5386 (or 60.2 per cent of the total). Of applications lodged in the same period, 5111 were from Hong Kong out of 7353 (or 69.5 per cent). These figures include family members. Similar trends can be observed in Canada. In 1980 Hong Kong was the fifth source for all Canadian immigrants, with 6309 admitted (4.4 per cent of the total). In 1988 Hong Kong was first, with 22887 admitted (14.2 per cent of the total). Of business program migrants to Australia from Hong Kong, 47.9 per cent settled in New South Wales, 24.5 per cent in Queensland, 13.4 per cent in Victoria and only 4.1 per cent in Western Australia.

If Canadian trends are replicated in Australia, which seems likely, there will be a large intake from Hong Kong into the 1990s, probably escalating towards the end of the decade. This will combine with continuing high levels of Chinese immigration from Malaysia, Vietnam, and possibly China itself. The encouragement of Chinese enrolment in education courses in Australia will obviously increase the likelihood of links being established, leading to eventual immigration. There will be a very substantial Chinese presence in some Australian cities and this could raise the temperature of the "Asian migration" debate. However, it cannot be overlooked that Canada has seen the potential of Hong Kong immigrants and that Australia must do the same if it is serious about raising the skill and entrepreneurial levels of its intake, as the Fitzgerald Report of 1988 recommended.

There is a wealth of talent in Hong Kong and some of it will actively be seeking to transfer within the English-speaking world and the overseas Chinese diaspora over the next decade. The numbers involved will depend largely on internal Chinese politics, which are currently unpredictable as throughout the communist world. Most "principle applicants" for migration from Hong Kong are likely to be well-educated and English-speaking. However this will not always be true for those they bring out under family reunion and there is likely to be an increased demand for service delivery in Chinese languages.

Dr JAMES JUPP

Director
Centre for Immigration and
Multicultural Studies
Australian National University



VIOLENCE

Australians used

to think they lived in

one of the world's safest

countries, but now we

know better.

Recent investigations show

that Australian cities are

dangerous places.

The reasons for this

rising tide of violence,

argues RICHARD

ECKERSLEY, lie in

poverty, family

breakdown,

drug abuse,

racial frustration

and alienation.

AUSTRALIANS ARE BECOMING increasingly fearful of violence — in the home, in sport, in the street and at work. A 1988 survey revealed that almost half the people living in Melbourne and Sydney did not think it was safe to walk the streets of their neighbourhood at night.

A recent Commission for the Future survey found that 92 per cent of Australians believed crime and violence had become worse over the past 20 years.

A study conducted in Sydney in October 1989 found that 90 per cent of people thought crimes of violence would get worse by the year 2000. In April 1986, a Gallup poll found that violent crime was the number one issue of concern for Australians, the first time since 1977 that unemployment had been dis-

placed as the top worry.

Do trends in violent crime support public concerns?

Historically, crime rates, including those for violent crimes, show a remarkably consistent pattern across a number of western societies, including Australia. From high levels in the early 1800s, they declined dramatically from about 1840 throughout the rest of the 19th Century and the early 20th Century. After WW2, crime began to increase, at an even more rapid rate than it had declined.

Australian Institute of Criminology statistics show that, over the past 15 years in Australia, the rate of reported serious assault has increased almost five-fold, reported rape has trebled, and reported robbery (theft with violence or the threat of violence) has more than doubled.

The murder rate follows the long-term trend, but not the short-term: it declined during the first half of this century until just after WW2, then rose. However, it has not matched

the more recent escalation in other violent crime, having levelled off since the mid-1970s.

Although historical trends in crime may be similar, crime rates vary greatly between countries. Australia is, for example, a far less violent society than the United States. Based on World Health Organisation figures for deaths by homicide (murder and manslaughter), Australia ranks equal fifteenth of 32 countries, with a rate higher than most Western European countries, but lower than North and Central American nations.

The NSW Bureau of Crime Statistics and Research showed recently that, on the basis of Interpol figures also covering 32 countries, Australia ranked third for rape, eighth for robbery and twelfth for serious assault and homicide. But different countries use different legal definitions and protocols for data collection, and the bureau notes that the whole notion of comparing one country's crime rates with another's is "rather shaky".

However, a new international survey, published this year, strengthens the view that Australia is a relatively high-risk country as far as crime goes. The Australian Institute of Criminology and the NSW Bureau of Crime Statistics and Research participated in the study, which compared the experiences of crime of over 2,000 Australians with those of people in 13 other countries. Such "victim surveys", while not foolproof, overcome some of the difficulties associated with comparing police figures.

Australia ranked third highest of the 14 countries in terms of overall victimisation — that is, the proportion of those surveyed who had been a victim of various crimes — behind only the United States and Canada. Australia ranked first for assaults involving force and for less serious types of sexual incidents; second for assaults involving threat; third for sexual assault; and equal sixth for robbery.

Possible explanations for Australia's high ranking include that we are one of the most urbanised of nations (the study found that big city dwellers are more than 50 per cent more likely to have been a victim of crime than those who live in towns of less than 10,000 people), and our mild climate (the study showed the risk of all major categories of crime clearly decreases the further a country is from the equator; possibly because a colder climate imposes an informal curfew on both offenders and potential victims.)

Crime rates also vary within countries and between different parts of the same society. The Northern Territory has by far the highest murder rate in Australia. The risk of death by homicide is much higher for unskilled workers than it is for professionals, and homicide is many times more common among Aborigines than other groups of Australians.

Violent crime needs also to be viewed in the context of other causes of death and injury. For every homicide in Australia there are about three deaths from accidental falls, six suicides, nine road fatalities and about 60 deaths related to smoking.

Trends in non-fatal violent crime have to be interpreted cautiously. Technological developments have

improved crime records, and because of shifting social attitudes — often reflected in legislative changes — it is now generally considered that many more crimes involving sexual assault and domestic violence are reported today than were reported a decade or two ago. So the trend in these crime rates may exaggerate the degree to which there has been a true increase in violent crime. How much of the recent rise in violent crimes (other than murder) is real, and how much a statistical artefact, we simply do not know.

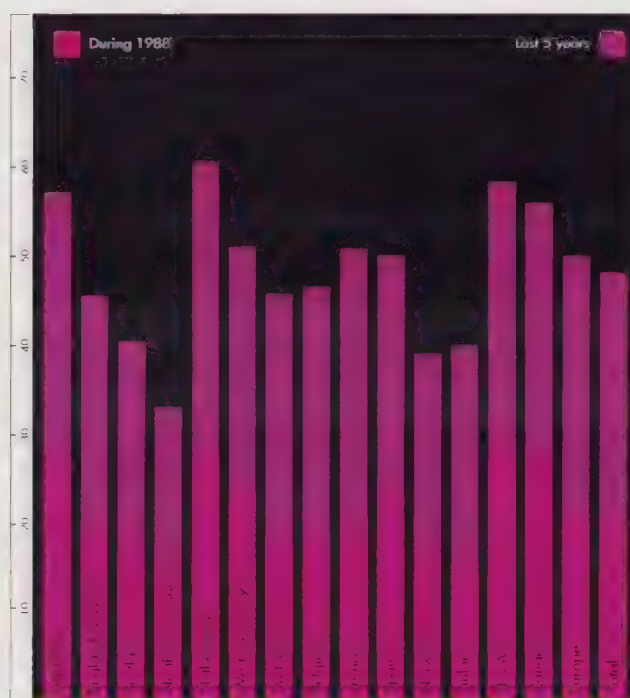
Nevertheless, the consistency of historical trends across a wide range of different cities and nations in the western world suggests, in the words of an American authority, that "the trends reflect, in a somewhat dis-

employment to both violent behaviour in individuals and levels of violence in society.

Depression and suicide.

There is now good evidence that, in western societies, depressive illness, once regarded as a malady of the middle-aged and elderly, has become more common among teenagers and young adults, with the increase particularly marked among those born after WW2. While depression has historically been two to three times more common in women than men, this difference may now be narrowing because of the increasing rate of depression among young men. Depression can lead to violence.

A Sydney study of mainly middle-class high school students



Overall Victimization Rates for all crimes.

Percentage of respondents who were victims of any crime in 1988 and over five years by country

Source: Experience of crime across the world. (Van Dijk, Mayhew, Killias, 1990)

torted way, real and profound changes in aggregate social behaviour".

A real rise in violence can also be inferred from trends in a range of factors that have been linked to criminal behaviour, including violence. These include:

Inequality, poverty and unemployment. Wealth has become increasingly concentrated in Australia in recent decades. The number and proportion of children living in poverty trebled between 1966 and 1986. The present unemployment rate of 6 per cent and rising, while down substantially from the 1983 level of 10 per cent, remains about three times the 1960s rate. A growing body of research has related poverty and unem-

ployment to both violent behaviour in individuals and levels of violence in society.

found that, among boys, the desire to hurt others was a more common response to feelings of severe depression than thoughts of suicide.

Also linked to depression is

suicide, an act of violence against the self. Suicide among young men (who commit most violent crimes) is rising. Among Australian males aged 15-24, it has trebled since the 1950s.

Drug abuse. Illicit drug use

has become a major social problem only in the past 25 years. Alcohol abuse among teenagers also has become much worse. The use of some drugs, notably alcohol and amphetamines, has

FIRST-HAND OBSERVATIONS

THE REAL CORE of the problem is that violence is male dominated and so frequently inspired by alcohol. As a police officer for 37 years, I observed at first hand violence in homes, on the street and in the arena of crime. I am satisfied that male aggression is biological and anthropological in nature and therefore extremely difficult to eradicate. It readily comes to the surface under the influence of alcohol. This trait has been there from day one and now, many thousands of years down the evolutionary track, we still see all manner of human aggression and conflict throughout the world. The problem-solvers are looking for quick solutions. I am afraid they will not be forthcoming. The answer, if indeed there is one, must also come from the processes of evolution. Through education, society must try to change the very nature of Man.

PAUL DELIANIS

Former Deputy Commissioner of the Victoria Police, now a feature writer for The Age and a commentator with radio station 3AW.

MANY COMPLEX CAUSES

THE NATIONAL Committee on Violence, which spent 15 months examining this subject, found that the complexity of violence is such, and its causes so numerous, that it is essential to resist the temptation of relying on simplistic solutions.

The prevention and control of violence is a challenge that confronts not only a wide variety of agencies across all levels of Australian government, but private and non-profit sectors, as well as individual Australians.

In the course of its inquiries, the committee identified three major priorities to deal with rising levels of violence:

- Adoption of a national strategy, aimed at promoting non-violent values, beginning with a national media campaign and incorporating the committee's specific recommendations in relation to education and recognition of the needs of victims.
- Additional regulation of those factors identified as aggravating the risk and extent of violence, such as alcohol consumption and ownership of firearms.
- Improvement in the availability of accurate information about the extent and nature of violence as a proper basis for decision-making, and as a means of reducing unjustified fear of violence.

PROFESSOR DUNCAN CHAPPELL

Chair, National Committee on Violence

STREET PAIN

THE OTHER WEEK I was held up at knife-point and robbed of \$150. Three young fellows pushed me into a disused lot, stuck a knife in my ribs and demanded money. I was very frightened. When I reported it to the police, their response was, "Consider yourself lucky you were only robbed. You could have been badly hurt." That made me feel terrible.

This graphically pointed out to me the other side of the story. Many young drug addicts and street kids I see have been involved in violent crime to maintain their lifestyles. Until that recent incident I had been able to detach myself from the "victims" as I heard the plight of the "perpetrators", the horrors of their addiction and what they had to go through to get their next fix; the horrors of home life that made living on the streets seem like paradise in comparison.

Public sympathy for the "cast offs" of our society is definitely declining and that worries me. Many kids and families need help, not locking up. Yet the resources are not there. The number of kids on the streets is definitely increasing — I have seen over 70 new ones in the past couple of months — yet resources are drying up. The drug problem is not declining either.

The aged have a vote but young people don't, so it seems services for young people are suffering in comparison with those for the elderly. Without more help, it is obvious crime becomes the only option for many young people and an unsympathetic society which says "lock 'em up!" only makes matters worse.

REVEREND BILL CREWS
Uniting Church
Ashfield, NSW

WINDING-BASED

SINCE THE TRAGIC shootings in Muddle and Queen Streets in Melbourne in 1987 there has been a rising consciousness of issues relating to violence in Melbourne and throughout Australia. The Victorian Parliamentary Social Development Committee conducted a detailed inquiry into community violence in 1988 and the National Committee on Violence has completed its inquiries.

The Victorian Community Council Against Violence was established during 1989. These bodies have talked, in particular, about the often unrealistic perceptions of levels of violence, the difficulties of gathering accurate data about levels of violence and the fact that violence often has its roots deep in the cultural and social environment.

Prevalent throughout these inquiries has been the notion that violence is gender-based. That is, it is overwhelmingly perpetrated by males.

Many practicable strategies have been proposed which I believe can have a significant impact on levels of violence in our community. These strategies include, for example, improved management and security practices in licensed premises, professional and public education programs relating to family violence, and restricting the availability of firearms.

JUDITH DIXON
Chairperson, Victorian Community Council Against Violence

been linked to violence, at least to the extent that it increases the likelihood that some people will behave violently. Apart from this link, there is the violence associated with drug trafficking and the robberies committed by addicts to get money for drugs.

Family conflict and breakdown. The divorce rate, while lower than the mid-1970s peak, when the Family Law Act was changed to make divorce easier, remains about three times that of the 1950s and 1960s. One consequence of the increased family conflict and breakdown that this trend suggests is the growth in the number of homeless youth, among whom violence is common. Another is the increase in the number of step-families which, research suggests, are more prone to violence than families in which both parents are related to the children.

Frustration, alienation. Recent surveys have found that many Australians, not just the poor, feel insecure, powerless, confused and pessimistic in the face of rapid cultural,

economic and technological changes. To the extent that this is making more people personally frustrated and socially alienated, it could be contributing to greater violence in our society.

'Over the past 15 years in Australia, the rate of reported serious assault has increased almost five-fold'

The media. Violence in the media, especially television, film and video, has been a part of our culture for decades. This violence has become both more common and more explicit over the past 20 years. While research has not clearly established a link between media violence and violent behaviour, the weight of

exposure to violence in the media could reinforce this inclination. Also, common sense suggests that media violence is likely to have a greater impact in societies where many people feel alienated, excluded and

disadvantaged, than in those that are more egalitarian and united. On the other hand, positive factors like good parenting can counter or mitigate the

effect of those that encourage violence.

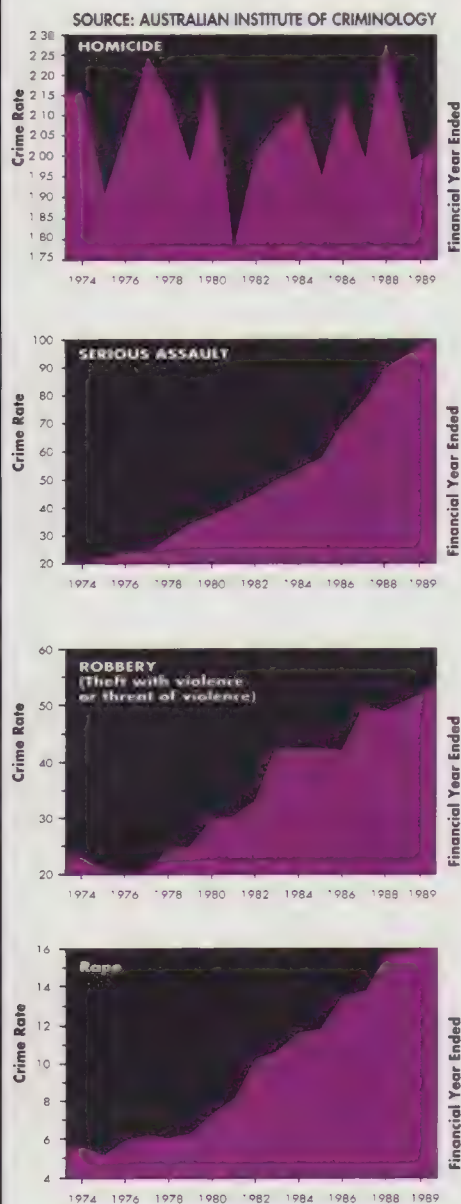
The consequences of rising violence reach far beyond the perpetrators and victims to affect everyone. There is the economic cost that we all must share. Despite the strong economic pressures on governments to reduce expenditure, NSW, for example, has almost doubled spending (in current dollars) on law and order since 1984/85 to \$1.7 billion in 1989/90.

The social and personal cost to Australians is even greater. Our whole quality of life suffers as our fear of violence, which may become quite out of proportion to the actual threat, increasingly limits our freedom to move about when and where we will, and taints our attitudes to others and even our relationships with suspicion and mistrust.

In his recent book, *Western civilisation in Biological Perspective*, Stephen Boyden, a professorial fellow in human ecology at the Australian National University, notes that the conditions of life that are conducive to good health include an environment and lifestyle that provide a sense of personal involvement, purpose, belonging, responsibility, interest, excitement, challenge, satisfaction, comradeship and love, enjoyment, confidence and security.

For more and more people, modern life no longer offers these qualities. This failing penetrates to the foundations of technologically advanced industrial societies. Australia and other western societies are unlikely to solve the problem of growing violence — or related problems such as drug abuse — unless they address this most fundamental issue of basic human needs.

RICHARD ECKERSLEY is the author of several reports for the Commission for the Future, including "Casualties of Change: the Predicament of Youth in Australia", an analysis of suicide, drug abuse and crime among young Australians.



These computer-generated images were shown at the international exhibition SIGGRAPH 90, held in Dallas, USA, in August, and an exhibition of Australian work at Sydney's Artspace in September/October. They are the latest examples of a new artform ready to shake the foundations of the art establishment. PAUL BROWN reports.

C O M P U T E R

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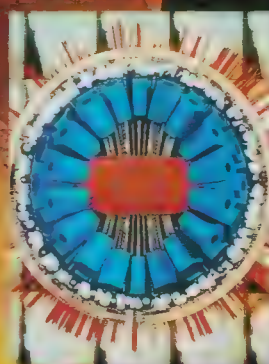


OIL PAINT IS a simple thing and its lack of intelligence makes it easy to simulate.

It trusts to be used by artists who use computers as tools, using pre-packaged software that emulates traditional techniques of artefact production like painting, drawing and photo-retouching.

Despite their limitations, these graphic arts systems have proved of value: they are non-toxic; they can significantly enhance productivity; and they have proved the viability of this new meta-medium to handle a diversity of styles and methods, ranging from the formal and often geometrical

languages of structuralism to the free association of surrealism and abstract expressionism.



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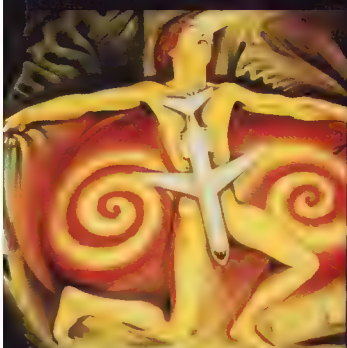


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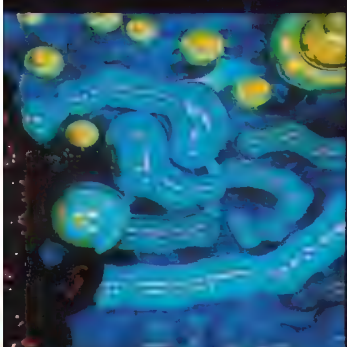
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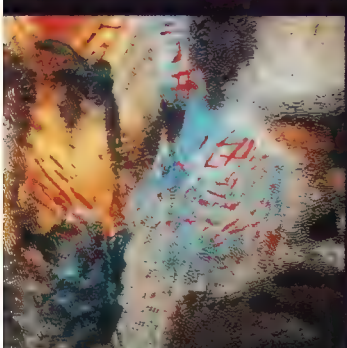
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© 1990 PIA SAUTON

A few artists have pioneered new ground and are helping to define the unique attributes of this information transaction-based meta-medium.

Two immediate potentials seem to offer themselves. The first is involved with establishing an interaction or intercourse between a human and an artificial intelligence (AI). The second is interaction between two or more humans mediated by an AI. Several artists, including the Melbourne-based Simon Veitch, have begun to investigate the former. Others, most notably Myron Kruger, have pioneered the latter.

Veitch is an artist who has pioneered an interactive system he calls 3-Dis. Using two or more small monochrome video cameras, volumes of space as small as a few cubic centimetres or as large as a whole room can be identified and tagged. Up to 96 of these volumes can be monitored simultaneously. When the contents of a volume changes, this can be converted by the computer into a command that can trigger any number of events like, for example, the control of a midi channel on a sound synthesiser or a remote surveillance logger.

The essential simplicity of the concept belies its application and usefulness. The system has the ability to independently track the behaviour of a large number of people or events simultaneously. Now the system has been proved in arts events (where groups of dancers created their own soundtracks) and installations (where fountains followed visitors about as they strolled around gardens at the 1988 Brisbane World Expo), the security people are getting interested and promise Veitch a new source of support. Kruger's installation at SIGGRAPH 85 in San Francisco used a single monochrome camera and clever edge-detection software to allow individuals and groups to interact with projected images of themselves, together with computer-generated artefacts like little green gremlins b-spline curves. What was particularly evocative about this exhibit was the way it encouraged people to play together. On several occasions I discovered salespeople in suits interacting with the most unlikely I partners — students in worn-off jeans among them — in a completely uninhibited, joyful and humorous way.

Many in the art mainstream have problems in getting a suitable handle on this kind of work. Their complaints mainly concern the lack of tangibility of the artwork — that



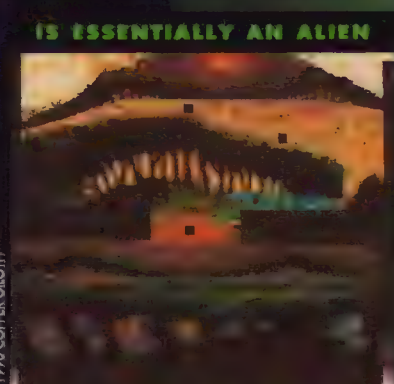
© 1990 MIDORI KITAGAWA DE LEON

LIKELY THAT WE WILL



© 1990 KAZUYA SAKAI

THE PRODUCT OF WHAT



© 1990 COPPER GILOTH

INTELLIGENCE FOR THE FIRST

TIME IN HUMAN HISTORY.



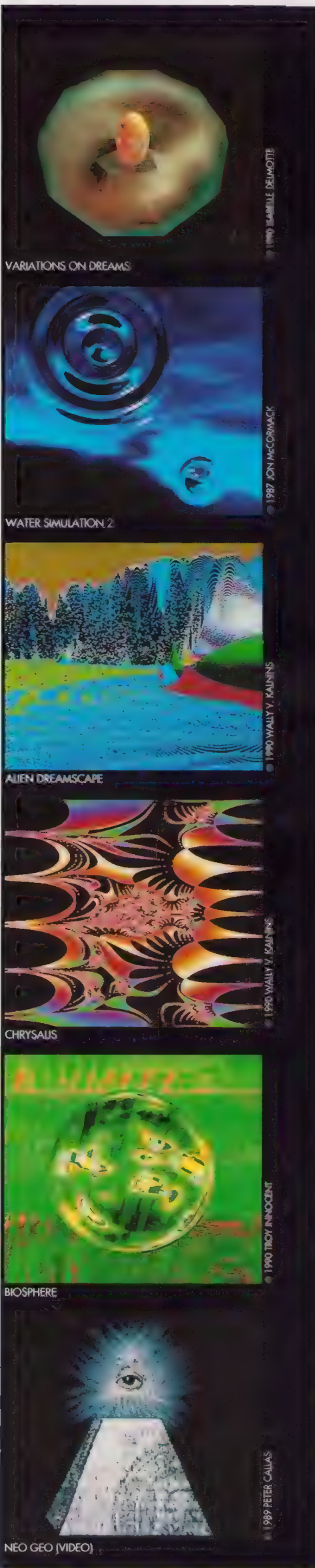
AUSTRALIAN IMAGES

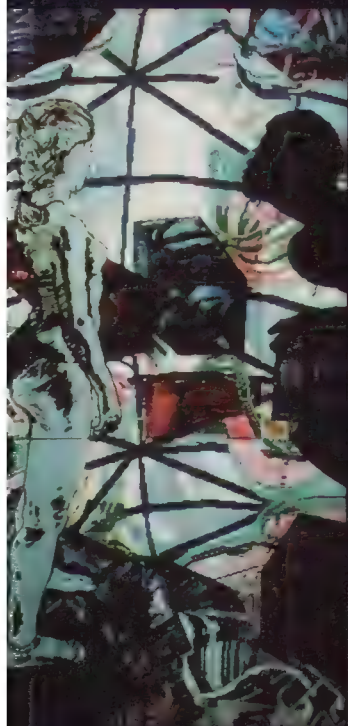
These images are selected from "Virtual Landscapes", a recent exhibition of computer-generated work by Australian artists at Sydney's Artspace.

Computer art in Australia is largely restricted to those with access to high-priced computers, scanners and software. These have been those dedicated artists able to beg, borrow or steal down-time on industry equipment, film and television people, or people with an artistic bent within the computer world. Few education institutions have yet installed quality computer-imaging equipment, so the medium is not widely accessible to students.

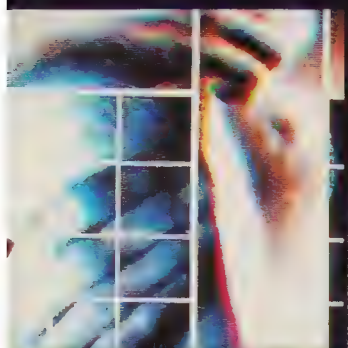
This will gradually change as costs come down and equipment becomes more widely available.

One of the big attractions of computer art is that you don't have to be able to draw. Scan in whatever image you want — a photograph, a leaf, a soup can label — and manipulate it to your heart's content on the screen. The computer will even translate mathematical calculations into images.





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it can't be framed, revered or monetarised. Computer art is not concerned with the production of artefact: it is exactly the inverse of those attributes the mainstream misses that defines this area's uniqueness and potential. Computer art, like Dada and many of the works of the Art Language and other conceptual groups, is essentially an ephemeral and virtual artform concerned with communication and interaction.

Practitioners should not waste their time trying to convince the arts mainstream of the value of their work. Putting energy into consolidating this movement is infinitely more valuable than wasting time trying to convert the high priests and culture vultures of the establishment who, in any case, are mortified by the threat to their quasi-religious and usurious value systems that this new and egalitarian artform endorses.

They will come over in the end, never fear; just as soon as they find out how to get an edge. Look at what they did to the Dadaists' dream of undermining the academy – the establishment now drinks champagne from Duchamp's urinal.

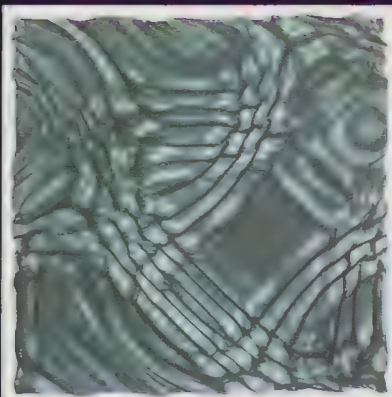
If today's artists can achieve so much with the limited computer technology that is currently available, we can look forward to a renaissance as they contribute to the development of a closely coupled human-computer interface, perhaps a direct link between brain and computer, and also to a fully interactive global network, complete with resident artificial super-intelligences.

By entering this global network, creative artists bring knowledge of a host of human experiences to the system, the expression of both intellect and emotion and, not least, the value of the celebration of existence. They also will bring the street-wise consciousness – an ability to survive, both within and from, whatever is at hand. And, most often their aims are benevolent – a quality they will do well to pass on to the new intelligence.

Eventually it is likely that we will see pure machine art – the product of what is essentially an alien intelligence – for the first time in human history.

While some are concerned about the religious, moral and ethical implications of such speculation, others rejoice in the fact that we may at last be able to create an intelligence that is capable of understanding the fragilities of the tenuous ecosystem of planet Earth, and may be able to help us remedy our past errors.

PAUL BROWN is an artist and Creative Director of the Advanced Computer Graphics Centre at the Victoria University of Technology. He was a member of the judging panel for SIGGRAPH 90.



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DR. P. D. TRIPLIP, LAUGHING STOCK OF THE ENTIRE SCIENTIFIC COMMUNITY...



UNFORTUNATELY, DR. TRIPLIP COULD ONLY AFFORD TO FREEZE HIS HEAD...



AND SO, DR. TRIPLIP'S LONG SLEEP BEGINS.



100 YEARS LATER THE DAYS ARRIVED!



REAL WEIRD SCIENCE

VISIONS



1P

Interviewed by Peter Hayes

PETER GARRETT is president of the Australian Conservation Foundation, and lead singer with rock group Midnight Oil.

What do you think young people expect of the future?

As a young kid growing up in the middle class of Sydney, I don't think I expected to find the world in as much turmoil as it is, nor did I expect to find that the predominant values in the world were as anti-human and anti-Earth as they are. So in that sense, the future hasn't realised its promise for me; it's realised something quite different.

I think the future is a perilous and extremely mixed bag of unknowns for young people, because the world seems to be delivering so much unhappiness. Consequently, I don't think it looks so good for them. The real equipment we need for the future is some degree of genuine identification of problems and how we might go about solving them. What's important is that we have a shared feeling in the community that we will actually address these problems, even if it means making sacrifices ourselves — in the way we live and the sorts of things we take for granted.

You seem to be saying young people have limited expectations. Don't you think it's a little sad that they are so limited?

Our society is so complacent and the adult world sends so many conflicting, hypocritical images to young people that it's not surprising that they are this way. I've always said this and I believe it deeply and strongly: young people have the potential, the idealism, the energy and the youth to be the driving force of commitment to change and of seeking some better way for us to live.

But they can't do it on their own. Our institutions — the political system, the churches, and the consummate bloody-mindedness and trenchant narrow-

there might be a World War III?

No. I never believed that there would be. Although I understood how perilously close we could come to seeing nuclear weapons fired in anger. That caused me a lot of anxiety then and still preys upon my imagination. But I always was left with the feeling that it would only be an irrational act of miscalculation and misadventure which would begin that process. However, there's every likelihood of there being some limited exchange of nuclear weapons through deliberate military policy.

Do you think the Cold War is definitively over?

No. I don't believe it is. It's thawed a hell of a lot though. I'm not a crystal ball gazer, but I think that it will metamorphose into something even more compelling, which maybe can be described as "Green Warfare". If you were in human rights you might call it "The Blood War". If you were in an aid agency you might call it "The Rice War" or "The Wheat War". Whatever area you were specifically interested in you might give it your own adjective.

The end of war — including the Cold War — is the breaking down of fears and insecurities which are held by either powerful groups or powerful nations seeking to achieve their own economic and national aims at the expense of the whole.

Over and above this, the problem is that we're now sharing the same backyard. Consequently, the Japanese — just to pick one country at random — gain from being able to get hold of cheap varieties of fantastic timbers from the Malaysian rainforest, which is both the indigenous peoples of Malaysia's loss and ultimately the world's loss because of the vast functions those rainforests perform in terms of their place in the whole scheme of a living Earth.

That's the new "war". But not in the sense of a weapons struggle. The Berlin Wall came down basically without weapons. I don't think weapons will be used in the Green War. But we are moving towards an extraordinary possibility for the human species where we actually provide for everybody that lives on the Earth by agreeing on how we share its resources.

the remarkably short period of time that white settlers have been here — how we've drawn on that stored capital — the forests, the oceans and the rivers. If we are serious about this idea of inter-generational equity — or to use a less complicated expression, leaving the planet in some decent shape for the people that follow down the track — then restoration is a very necessary part of that process. Lake Pedder could shine again.

How do you see the relationship between Asia and Australia in the future?

Extremely thorny. But it is absolutely essential that we develop good, open relationships with Asian nations. It is a powerful economic region in which we are implicated because of our geographic position. We aren't skilled traders as a nation; we aren't expert business people. We have, though, an extraordinary range of natural resources which those Asian nations will be seeking to exploit. So it's absolutely essential for us that we think through very carefully how we want to manage that exploitation.

That needs to be done in a wise, conserving manner which generates real long-term employment and real earning income for the country and doesn't run down our environment. We certainly shouldn't sell short the resource base of this country simply because there's a short-term economic gain from a region that has a great capacity to take a lot of what we have here very quickly and really not pay much for it in real terms.

How are these kinds of social and political messages reflected in the lyrics and form of the Oil's music?

It's no mystery that Midnight Oil is a band that has sung about issues, but we've always considered them life issues. We've never considered them ideologies or particular philosophies or the following of any one party line. We've simply sung about things we've seen and felt strongly about, and I guess we'll continue to do that for as long as the band is making music.

Our audience takes us — and every other band —

ness of the economic system and the dogma that's associated with the corporate world — all these have failed. We raise generations of people, a majority of whom have a greater concern for whether they'll have a nice car, a good-looking house in the suburbs and be married to the right person, than they are about the very profound issues that everybody is going to have to wrestle with in the next 50 to 100 years.

To what extent do you think that mass communication has made a global consciousness possible, and how do the Oils involve themselves in the generation of that consciousness?

We are seeing a global consciousness to a limited extent. People all around the world have a gut reaction to issues like poverty, environmental destruction and really poignant political struggles. Most global consciousness has come about as a result of pictures, not words. Pictures are very effective at saying things simply, but I think that the delivery of those images is often not accompanied by sufficient other information, and you are left with the feeling that you don't really know much more than you did before.

As far as Midnight Oil is concerned, we see ourselves as one of the myriad fish swimming in the big pool, but as having a purpose other than self-aggrandisement. We see ourselves as speaking for our own generation, never mind the generation who are younger than us. Sometimes we're too preachy in the way we speak to people. Sometimes we're perceived as being too serious, or tilting at the windmills we see around us. But underneath all of that is a very strong gut feeling that the things we are saying need to be said, and we can't hear other people saying them. We'll keep on saying them until we start to see some response — until we start to see problems being dealt with.

When you were working very actively in the peace movement a few years ago, did you really think that

How do you see the future of the Australian Conservation Foundation?

I think that the ACF will play a primary role in shaping the national ethos that Australia develops in the next decade. It will be an organisation which works at the levels of activism, in terms of protection of wilderness areas and environments under threat. But probably more importantly in the long term, it will hopefully be one of the major agents for a complete change in thinking and a change in national priorities. Which is more than can be said for either of the major political parties which are both still setting us up on this speeding treadmill of constant economic growth and supposed improvement in living conditions for everybody.

Do you see the Green movement moving beyond confrontation over projects that threaten the environment?

We're happy to move beyond confrontation, but we'll always be at the barricades if government and industry continue to introduce development projects which will have an adverse impact on the environment, without properly consulting with the community beforehand. It's really not entirely proper to put the ball in the court of the environmentalists: it more properly needs to be in the court of large corporations and governments, both State and Federal, but particularly State, which make decisions behind closed doors and launch them with great fanfare, then run for cover when everyone says "What about the organochlorines?" or "What about the farmland, or fishing?"

There is also a Green agenda to restore the damage that's been done in the past. Do you think the original Lake Pedder should reappear — that the dam should be unflooded?

If it's feasible, I think it's a terrific idea. It would be a great symbol. The most significant thing about the environmental debate, which we all lose sight of, is the mega-scale that we've wreaked on the place in

on the basis of how we make them feel as well as what we say. We're as much into the emotional response and the physical side of entertainment as we are into the provocative, deliberative side of speaking out through the songs. At the end of the day, people love going to rock concerts because they like jumping up and down and being with their friends, and dancing and seeing the band and the lights and feeling the sound — it's a great physical experience, a release from everyday life and a lot of fun.

There are five billion people on the planet today. Do you think we'll make it to the 22nd Century?

Yes I do. I have an extraordinary — you might say crazy — faith in the human species; I'm not as down on humans as some people sometimes are. There are a lot of things we can look at that suggests we haven't quite got it together, but there are other things to show we do have some enduring qualities. We have the ability to make rational choices, to distinguish between fundamental rights and wrongs, our capacity for adaption and creativity, our utilisation of resources, our inventiveness; all those things, coupled with the fact that the planet we inhabit is a unique, extremely productive life-support system for us.

All we have to do is grow up a little bit, move out of our pre-pubesence, stop staring at our noses and trying to get what we want instantly, and recognise that part of our task is simply maintaining and working with that home we have. Once we start to do those sorts of things we'll see a very different kind of human community. But it isn't population that's the greatest problem in my view, it's the attitude of the human heart and the human mind. If those things come good, we'll be able to feed, clothe and house sufficient people. Maybe not all of us with the kind of material affluence you and I take for granted now, but we'll still be able to do it. I'm convinced of that. ■

VISIONS



serious rock

FACING THE FUTURE

MARK SEYMOUR is lead singer and lyricist with the band Hunters and Collectors.

How effective is rock music as a medium for communicating worthwhile ideas?

One good thing about rock music is that you can hit people over the head with some really basic statements and they'll accept them. There's this instant connection and people expect to be communicated with on that level: it's a pretty basic level, but you can always assume you're going to get some sort of point across.

If there's a subtext to what I'm trying to say in a particular lyric that's very psychological or dark, I don't expect a person to automatically understand it. But if I want to say, "There's a hole in the ozone layer and civilisation's burning our skin," or whatever, I know that I'm going to be able to yell it out over a microphone and people are going to go, "Yeah, right, that's true." That's the great advantage rock music has — that you can make the most obvious,

based on knowing how to find information and use it to your own benefit.

It's less likely to occur to people who come from places like Penrith or Parramatta that information is an important part of how their consciousness can affect their future, and how able they are to be successful financially. That's why I think that people who say Australia's a classless society are basically ignorant, or they haven't seen enough of Australia. We are class-bound; there is a radical difference between rich and poor.

What kind of prospects for the future do you think people have now?

At the moment, people's consciousness of the future is controlled by fear, and that's directly related to how much information is available to them, principally through the media. I think the media basically controls people's consciousness.

I'm familiar with the recording industry, which is quite an important part of the media. The general sense I get is that the recording industry is pretty much out of touch with the fact that the ongoing images it presents to youth affects their consciousness; it's just a series of images which are thrown out into the marketplace.

So what do Hunters and Collectors stand for?

I don't say, "We're about this particular issue." I think that what happens with rock music is that the media will put a label on you anyway, and I think all I should do is to be quite honest about what I'm responsible for, and that is to be eloquent and make intelligent statements. I'd rather have my credibility as a poet well and truly intact and let the media take care of the rest of it themselves, because they will anyway.

The first thing we did for our album 'Ghost Nation' was to write a lyric about people's fear of the future, which is called "When the River Runs Dry". From there, I started dealing with a number of different aspects of that: how that fear is manifested, for example. One of the ways I dealt with that was with a song called "Ghost Nation", a description of the urban landscape in Surfers Paradise, which to me is an exemplary symbol of Australians' inability to come to terms with their sense of time and place.

I mean, this place is an urban desert stuck right out on the eastern tip of the continent, and they've just drained all these marshes and built these towers where the elderly of Australia go to live after they've been superannuated, so they can look down over the verdant fields and say "I'm free at last!" It's incredibly sick, but it's amazing how people just take it for granted.

Do you make any observations about Japanese investment in 'Ghost Nation'?

Yes, there's a little hook at the end of the verse which goes "Too old to move, too rich to ignore, Garden of Eden on the South Pacific shore, sweet wonderland. No horizon, no borderline, too far away to know or to find, sweet wonderland." *

When I was asked about my attitude to the fact that a large proportion of Surfers Paradise had been bought up by the Japanese, I said, "You're crying over spilt milk." This is the new empire, the Japanese have arrived, and I think we're just going to have to wear it. I'm very fatalistic about it. But you've got to be really wary of people's prejudices and fears about the Japanese. We welcome the Americans with open arms.

How do your values relate to those of your parents?

They both had a fairly strong religious upbringing. They've been religious all their lives. They still go to church every Sunday and confession and all that kind of stuff. But there's a consistent line right through their growth as adults. They haven't had any major disruptions to their relational growth, they just made a few basic decisions in their early twenties and steered their course based on those decisions.

Whereas with people like myself, we go through a period where we change quite dramatically over 15 to 20 years, and our relationships with people change too. People my parents' age had a simplicity — they didn't question their relationships with each other that much. They may have questioned political movements — they went through war, so those sort of things tend to override the more domestic strife

that people have. I think people grapple with what they believe to be right and wrong in their own time, in their own way.

I think faith is a really profound idea and that, to me, overrides everything else. You can't have love without faith. It's very much a personal thing and I'm not advocating a religious attitude by any means — it's a state of mind more than anything else — but I think faith is a really critical factor in the whole scheme of things.

And you connect that with the need to have optimism about the future?

No, lack of fear. See, if you talk about optimism and pessimism you're talking about someone thinking something good's going to happen and someone thinking something bad's going to happen. I'm not suggesting I know what's going to happen; I don't think anyone should expect to know, but we shouldn't be frightened about it — and that's where the whole idea of faith comes into it.

Like for example, the environment is becoming a really profound political issue — and I'm glad that it is — but I think that the way the environment has become is part of a far more pervasive and deeply rooted problem to do with people's belief in the human spirit and their lack of faith in each other and themselves.

Do you think that a global consciousness is possible?

Yeah, but I don't think it's something that's going to come about because everybody turns their minds to it. I think it's something that will come about very slowly, and there's going to be a hell of a lot of grief in the meantime.

Why grief?

Well, you've just got to look at the events of the past few years, like what happened in Beijing. That's created an amazing change in people's consciousness about what's at stake if we want freedom globally, and how responsibility and freedom are inextricably bound together. But there will be grief. Unless Australia can buy itself enough time to change the way its economy is structured, there'll be a lot of poverty in this country over the next few years.

What do you think of the prominence of the environment as a big social issue on the agenda at present?

I'm extremely pleased and relieved that it's becoming a hot potato. It is great to see that it is beginning to have a really profound effect on people's consciousness. Still, in the end — two things — first, corporations that make products that we buy have to come around to thinking that waste is more expensive than effective waste disposal. It'll be the bucks that will decide whether or not we save the planet. Most of the world's economy is still controlled by free enterprise, and you've got to motivate people who are interested in making money.

Secondly, on a more philosophical level, I think that the problems we have with the environment are part of a far more profound and deeply rooted human problem, which is that we don't have a lot of faith in ourselves. Humanity has a suicidal streak, and we've always been on the razor's edge in that regard.

It's not new: the environment crisis is a continuation of the nuclear proliferation crisis; it's just another part of that basic problem human beings have. I see it as being tied into what it is about the human spirit that fascinates us all — people's awareness of themselves as beings.

The most important thing about the environmental problem is that it addresses one of the fundamental natures of human society, which is this idea of expansion — which is wrong.

Building things is great, but for what reasons? The Greens, as a political movement, address those fundamental questions. The other day I got my hands on the German Greens manifesto. It's incredibly wide-reaching. The German Greens have a strong political voice in Germany, but only because they have a manifesto in which they deal with human society as a whole. They talk about the social values. We think Greens and automatically think woodchipping and people standing in front of bulldozers, but that's really only a small part of the agenda. ■

2

even prosaic statements and you'll be taken seriously.

So what points would you like to put across in your music?

I still tend to talk about human spiritual issues that are really based on how I feel. Anything else that comes out of that, whether it be political dialogue or a lyric about the environment, is based on how I feel about it, because I think that to communicate with people politically, you have to address the way they feel. If you use slogans, it's a non-communicative way of talking: people tend to think "Oh no, I've heard all this stuff before".

The thing I'm most concerned about is that we shouldn't be frightened of the future. That's the big trump card that corporate capital has in controlling people's lives. Capitalism maintains its energy by keeping the vast bulk of the people who produce the goods that keep the thing going in a state of fear of the future, by being denied basic information about the way things work.

I'm not waving my red flag here, but I've got basic socialist values. I think people should be inspired to believe in themselves and the fact that the world is fundamentally a good place; that life is full of endless possibilities — you can do things — and that fear is a really destructive thing.

Would you say then that the traditional critique of capitalism — control over the means of production — which was the issue in the 19th Century, has become control of information as we move towards the 21st Century?

I think that's the real issue. The status quo is maintained, and power organised in this society, by access to information; and that's where you get class differences. That is why people who come from the North Shore of Sydney are more than likely going to end up having successful jobs and making a lot of money. They learn from a very young age what it means to have entrepreneurial skills, which are

VISIONS

BRAIN



BARRY JONES MP was Minister for Science from 1984 to 1990. He is currently Chairman of the Federal Parliamentary committee for long-term strategies.

MANY AUSTRALIANS are distinctly uneasy about the concept of "vision". We have grown up with a strong, pragmatic tradition.

Our habitual Philistinism has been moderated in the past 25 years, with the increasing importance of feminism, environmentalism and the arts. Nevertheless, we don't have a great feeling for the speculative, the philosophical or the long term: an aspiration for the 1996 Olympic Games to be held in Australia and the thrilling prospect of sporting items dominating the front pages for the next six years seems to be as far as we can go.

A visionary is seen by many Australians as an eccentric, somebody out of touch with reality. The word "visions" suggests somebody who hears voices, like Joan of Arc, and looks so far into the distance that they can't distinguish what is going on here and now.

Our current preoccupation with economics, and the tendency to confuse value with cost, makes us

part of goals and plans. We need to look 15, 20, 25 years ahead, not one, two or five. Having goals, and developing plans to realise these goals, must not make us inflexible. Our objectives should not be set in concrete: at times there will be a need to respond rapidly to changing circumstances, to take up new opportunities, to stop pursuing unprofitable (in the widest sense) avenues. To be flexible we need to be more alert, more robust as a nation, more ready and able to turn around rapidly.

Donald Horne coined the term "lucky country" ironically: lucky to have resources, lucky not to have to work or think too hard. But resources themselves don't guarantee quality of life (Brazil and the USSR confirm that). World circumstances and terms of trade have moved in a way which makes our resource-based economy particularly vulnerable. We have a desperate need to develop brain-based industries, to bring a thoughtful, intelligent approach to our economy, diversifying our sources of export earning and perhaps reducing our reliance on imports (without resorting to futile import replacements behind artificial barriers).

Our greatest resource is an educated, skilled

communication, transport, environment, services of all kinds. We are well placed to contribute to the solutions. One way is to build a city, or cities, demonstrating some of the answers as we know them now but, more importantly, to research and develop future solutions — develop and sell products and services, such as CSIRO's SIROFLOC water purification process and other enlightened water, waste and sewage treatment processes.

Another issue to explore is energy use and its efficiency. We can't continue to rely as heavily on private vehicles. Recently a very enlightened car-maker, Pehr Gyllenhammer, the chairman and chief executive of Volvo, urged less reliance on cars, especially for city centre use. He was taking the long view (a vision, if you like). He was thinking of the environmental consequences, unlike some of his industrial competitors and many consumers.

The conventional, short-sighted view says, "Sell more cars. Build more roads. Drill for more oil. Ship out more coal" — as if only "now-time" has to be taken into account. I hope Gyllenhammer's thinking dominates in the coming decades if we are to have a planet worth living on. The MFP, whatever its form,

MFP

concentrate on accounting, the bottom line, cash flow and factors related to survival from year to year. This mental set is hostile to long-term research, to exploring options for the 21st Century. There is a false dichotomy which emphasises the immediate and denigrates concern about the future and which may paralyse our capacity for imaginative responses.

The last year has been the most extraordinary year in international politics since 1917, or perhaps 1848. Events unfolded in the Soviet Union, China and Eastern Europe at a bewildering speed: bewildering, it appeared, not only to the world's media, but to the diplomatic and intelligence services, whose impressive resources of hardware and software spread world-wide gave them no special insight into what had happened, what was happening and what was likely to happen. They were in the dark too.

The Cold War is over — by declaration. Does this mean that funds can be diverted to new items on the political agenda? Protecting rainforests, restoring the ozone layer, improved waste disposal, clean air and water, elimination of pest-borne diseases, preserving diversity of species, limiting world population growth? Don't count on it.

Among many of the largely unnoticed (at least in Australia) events of the last 12 months was a marvelous speech by Vaclav Havel in receiving a peace prize from the German Booksellers' Association. He wrote of the need to treat words — even exciting, arousing words — with caution, to study very carefully what people are saying, to examine and analyse and then to accept or reject as appropriate.

"We have developed a profound distrust of all generalisations, ideological platitudes, clichés, slogans, intellectual stereotypes and insidious appeals to various levels of our emotions, from the baser to the loftier," Havel wrote. "As a result, we are now largely immune to all hypnotic enticements, even of the traditionally persuasive national or nationalistic variety."

You should apply the same caution to my views. But don't stop at caution: knowledge, analytical skills, intellectual rigour and courage have to be brought to bear.

We need to set long-term goals. Not just goals to win more Olympic medals. Not even just goals to get the inflation rate or the bank interest rate down to such and such a number — though these might be

community. In their lifetimes, our children might expect to be trained and retrained several times to meet changing needs: that adaptation to change, that flexibility and resilience needs to rest on a strong, deep educational base. We need to be a literate society: it is essential to assist our one million illiterates to overcome their problem and to be able to share in, and to contribute fully to, all the benefits of our society.

I certainly hope that it will not be too much longer before we have thrown off the last vestiges of our colonial cringe. We still all too readily believe that we are not as capable as others, that "they" somewhere else in the world have all the answers, or can certainly do it or build it or solve it better, so why should we even try? We are crippled by our past attitudes. We made errors of judgement in deciding not to follow up our pioneering work in computers, in transistors, in photocopying, in space activities. Let's try harder in future, based on a optimistic view of our capabilities, including our capacity to do more with our excellent research.

Surely in the next century we will develop more self esteem, more confidence in our ability to decide what to do and how to make it work for our benefit. We must. And yet, I can hardly be confident when I look at some people's panicky reaction now to the still emerging, still developing Multi Function Polis (MFP) idea.

The whole concept is still far from properly understood — as a concept, let alone in terms of the possible forms of realisation of this international, forward-looking project. I hope that the coming months will see a much better and more intelligent discussion of the possibilities and a sense that a whole host of exciting, important, innovative things could occur under the MFP banner if only we are willing to seize the initiative, to be bold and forward-looking, as once we were as a nation.

There are vast opportunities in the MFP idea if we turn it to our benefit. In a new city or cities, and in our existing centres too, we can begin to play our part in tackling the vast problems of cities — not just for idealism's sake, but to develop and sell products and services. In 1950 there were 50 cities with populations greater than one million. In 1990 there are 260. By 2000 there will be more than 400. Many of these large centres have problems — of health,

could look at new forms of energy — positive, and profitable things.

There are a lot of other things which I could list as components or prerequisites for a 21st Century vision, but I will close by mentioning one key factor. We must understand more of the world we live and trade in. We must understand more of the cultures and aspirations of our Asian and Pacific neighbours in particular.

We must stop seeing the future as an infinite extension — physically, culturally and socially — of the past, with all the self limitations inherent in that. We have new circumstances, new social and ethnic mixes, new challenges and we must apply ourselves to meeting those challenges. If we do, then the 21st Century will be an exciting, satisfying time to be alive, and those alive then will thank us for our initiative and vision. ■



ALEX PUCCI is a Sydney-based biotechnology analyst.

This view of the future is optimistic. It implies that, despite the damage they have inflicted on the environment, people will develop a need and a desire to repair and find solutions.

No longer wishing to control it, no more eager to exploit it recklessly, the new person will be able to live on Earth under appropriate rules of sustainable development.

People will have finally understood the relative importance of their presence on the planet, the futility of their earlier anthropocentrism, the secrets of renewable resources, the importance of biological tools and the possibility of a dynamic bio-

must, be preserved as they are now; that every plant and animal maintain a static habitat, not to be disturbed by human action. This concept, of course, disregards the natural changes of our long past, the major and minor cataclysms that continuously occur on Earth and the evolutionary mutations that continue to involve every living organism.

In its long prehistoric past, Earth has experienced many climatic changes, some of which were due to living organisms. When large amounts of oxygen were released into the atmosphere by Cyanobacteria, most other life forms disappeared, poisoned by the lethal gas. New forms of life then evolved, thriving on oxygen.

Whenever possible, however, the inevitability of change has to be managed wisely if we wish to

millions of years. The chemical reactions responsible for energy deployment have modified to achieve an ever-increasing degree of efficiency.

This relentless trial and error has produced a marvellous system and one that should be observed and followed as a model. Several lessons may be learnt by observing natural mechanisms.

Re-utilisation and storage of energy in nature should provide instructive examples. Nature's capacity to save energy and to renew resources, its efficient systems of reproduction, photosynthesis and catalysis, should be directly exploited.

Many possibilities exist. For instance, it is anticipated that in 10 years' time treated waste from forestry, farming, industries and cities will provide at least 10 per cent of Europe's energy

ALEX PUCCI

VISIONS

equilibrium. At the same time, a better knowledge of the complex web of biological and physical events occurring on Earth will have convinced people to shed the simplistic elements of the conservation movements in order to implement relevant and effective efforts.

My ideal 21st Century is therefore characterised as a post-conservationist era — biological economy and bio-logic; and conscious, balanced bio-dynamism.

Life, in every form known to us and within our solar system, is at present Earth's exclusive domain. By an extraordinary confluence of events, life originated and evolved uniquely on our planet. This uniqueness is awesome and carries with it a high responsibility. People must protect this privilege, must understand the events unfolding and must act in harmony with them. Knowledge and appropriate action must be carefully developed.

An immediate dilemma arises: by what means should the fragile biosphere be protected? Total conservation or biological dynamism?

In the late part of the 20th Century, movements have emerged to protect and preserve the natural environment. The uncontrolled and at times irresponsible actions of private and public "exploiters" had to be checked. The immediate, and in some cases urgent, aim of the conservationist groups has been to stop the dumping, logging, damming, construction and development that were having a negative impact on the environment.

This was clearly a mandatory priority. In the process, though, several misconceptions have found their way into the public mind. The most general is the notion that all forms of life on Earth can, and

avoid a catastrophe. Humans are now producing changes to the global environment which may have a disastrous effect on our climate and on future life forms on Earth.

This is both unacceptable and ironic, since humans are the first creatures on Earth with the capacity to consciously affect the environment. Thus our ability to discriminate between damaging and beneficial actions ought to be effectively deployed. To do so, actions have to be based on sound knowledge of current ecosystems, of how these systems evolved and whether they are balanced in their structure and composition.

Palaeontology, zoology and botany have given evolutionary and current accounts of life on Earth. These disciplines will continue to contribute to our understanding of the ecosystems under threat. In the future, fundamental biology will become more relevant, since it will reveal mechanisms that may serve as models for sustainable development in order to protect and manage biotic diversity in balanced ecosystems.

Knowledge of the multiple mechanisms that regulate life on Earth will be crucial to the solutions needed. The post-conservationist era of the 21st Century will thus have the distinct advantage of bio-logic versus the emotional simplicity of thought in the late 1900s. Let's see how biological models may help to find the solutions.

Living organisms have evolved most efficient systems to utilise energy. Organisms and their cells are equipped with apparatus that operate at the lowest possible level of energy consumption. This optimal energy utilisation has been acquired through numerous evolutionary changes over hundreds of

needs. Other bio-fuels may reduce oil imports by 20 per cent, according to recent estimates.

A better understanding of renewable biological systems should help in developing a new approach to natural resources. Clear benefits from methods like replanting, somacloning, plant tissue culture, aquaculture and biological pest control should ensue. Biological systems are effective models also because of the complex mechanisms that lie behind important functions such as vision. It is well known that the eyes of insects are extremely sophisticated organs. Their models may be used with potential economic gains.

One area that could clearly benefit from such prior art is robotics. While electronics has provided useful tools for the development of robots' movement, little progress to date has been achieved in the development of vision. Insect eye functions may provide some of the answers.

Another type of exemplary and efficient economy in nature is given by the nervous system of insects. Flight capability in the tiny fruitfly is controlled by a few millimetres of brain with very fast action. In split seconds, a fly can compute simultaneously altitude, air speed, angles, pitch and roll co-efficients, muscle tension, wing beats, direction of flight, incoming odours and objects. Compare the insect's "hardware" with the flight control panel of a Boeing 747 computer, several thousand times bigger than a fruitfly, and the economic argument becomes obvious.

Other economies are evident in the manufacturing of newly developed biotechnology products. One example is given by continuous cultures of organisms genetically programmed by humans

to secrete vast quantities of the required product in the surrounding liquid. Like bacteria and yeasts before them, some insects have also been used in this manner, with major results. Apart from economy, the other advantage of such systems is the biological, rather than synthetic, origin of the products.

Another important characteristic of biological organisms, such as bacteria, is of course their digestive capacity, which can be utilised to extract precious metals, break down obnoxious material, separate lignin from wood, and polymerise.

In a further field, communication, cells and living organisms may provide important new models during embryogenesis for instance, cells have an uncanny awareness of their position and their functions. How was all this communicated to them?

may be easily extrapolated and used as blue-prints for ethical, behavioural, social and economic systems.

Knowledge of the models that bio-logic provides presents us with alternative solutions to the indiscriminate damage we are inflicting on the environment. The availability of superior alternatives renders morose to an even higher degree the continuous use of damaging methods. Ethics should therefore be strengthened to restrict further action that may produce a negative impact on the environment.

As the notion of criminality is enlarged to include crime against the environment, a stricter moral code should be introduced. Not just fines for the polluting industrialist, not just halting the wrong property development. The new ethics would condemn crime

bio



Methods of communication as yet unknown may be uncovered by the observation of contiguous cells.

An extremely important and general principle that pervades biology is homeostasis. This relies on the ability of living matter to modulate its functions at all times, to stabilise and maintain the required equilibrium. Any biological action induces a counter-action which intervenes every time the equilibrium has been shifted. For instance, during an immune response to a foreign organism, antibodies are produced against it. At one point though, as the blood carries the antibodies produced, a counter-action takes place to suppress any further antibody production and bring the blood gradually back to a normal level of circulating antibodies.

This principle, essential to life, represents a balancing model that can be widely applied. The application of course will be possible only with a good understanding of equilibria, of what they depend on and of when they have been disturbed.

Biological models also provide vivid examples of non-linear dynamic systems, otherwise identified with "Chaos". The theory of Chaos seems to apply to most physical and biological systems, but the latter appear more representative. Biological models show how overwhelmingly complex systems can emerge from simple beginnings. The predictive value of these models is very high.

The benefits of biological methods are many and varied. They provide ways in which resources can be maintained, renewed and utilised efficiently. Biological models provide well-tried mechanisms for mechanical or other artificial functions. Bio-logic provides well-reasoned ways to find environmentally safe solutions. The bio-models so far described

against the environment as crime against humankind. The wide base of condemnation, in addition to official punitive action, should provide a powerful deterrent to prospective offenders.

On the behavioural front, the improved environment will benefit people. Knowledge of what is a better environment for people will also help them overcome the difficult adjustments they experienced in the industrial era. Knowledge of what is good for them will also determine how people will act at work, and at leisure. The vicious circle of a deteriorating, overworking life, led in order to acquire material goods which make life more bearable, will be broken.

Improvements in the behavioural sphere will be followed by better health a reduced need for medical intervention. People will in fact be able to apply a variety of preventative measures, thus further decreasing the need for hospitalisation and treatment. Home diagnostic devices should be widely available. In addition, genetic analysis would provide advance notice of individual susceptibility to disease, and a finer knowledge of deleterious side effects may reduce the amount of drugs consumed.

Equipped with the necessary basis for change, people will be at ease with the inevitability of a dynamic future and will move with it. Bio-dynamism — defined here as the combined changes which advance the optimal continuation of life on Earth — will be the most suitable form in which the future will occur.

The conscious knowledge of change, humankind's preparedness for it, and our ability to balance ecosystems to obtain sustainable development will produce a novel and most elegant equilibrium. ■

logic

J

VISIONS



Judith Wright is one of Australia's most eminent poets.

OVER THE PAST 20 years, some of the problems Australia and the rest of the world faced approaching the end of the 20th Century have been greatly changed. But much still remains to be done.

For Australia, the great problem of conscience, the status and treatment of Aborigines, remains a running sore: although the long series of negotiations over a treaty, finally undertaken by the fourth Hawke Government with independent representatives of the Aboriginal people, plus the urging of the United Nations General Assembly through its ratification of the Declarations on the Rights of Indigenous Peoples, brought reconciliation closer.

With all Australia's moneyed interests, and those of the world's mining industries, bitterly opposing any concessions to Aboriginal rights to land and to veto on damaging developments, the struggle Aborigines have faced has been great. Not until the Federal Government finally asserted its power and abolished States' rights, thereby saving the country millions of dollars yearly as well as much international embarrassment, are the negotiations nearing a conclusion. But the needs, and the world-view, of Aboriginal peoples are never likely to be solved in terms acceptable to the still-dominant Euro-Australian community.

Nevertheless, the collapse of the assumptions of Western superiority, technical and technological infallibility, and of the masculine linear-thinking approach, has led to a gradual realization of a new set of attitudes, and of the truth of Bill Neidjie's words in the 1980s: "Earth just like mother and father and brother of you."

We are no longer trapped in the remnants of a frontier-colonial psychology, and can understand the need for rapport with the Earth and with those who have been its guardians for millennia. For years all the negotiations towards a true settlement were vitiated by ancient greeds and market-based institutions and industries. Though so many of these have vanished or been undermined by the miseries of the end of the 1990s and the early part of the 21st Century, we still retain the scars of old injustices and hatreds.

The closer communication of the two communities was led by a recognition on the part of the increasingly influential environment movement that the outdated "wilderness" concept which, in effect, denied Aboriginal rights to land, should be revised. Taking Big Bill Neidjie's lessons to heart, the movement now works co-operatively with, not against, the victims of Western invasions and technologies.

But at the beginning of the 1990s, the strength and the cunning of the world-wide industrial, military and trading nexus seemed unbreakable. Only the despair of the peoples of the northern hemisphere, as the cumulative effects of industrial pollution and the exploitation of forests, soils and seas, choked, poisoned and killed so many thousands, broke the power of those interlocked systems. Nuclear and chemical accidents, increasing so rapidly as equipment aged and deteriorated and could not be economically replaced, were gradually seen as not accidental at all, but embodied in the nexus between human and machine.

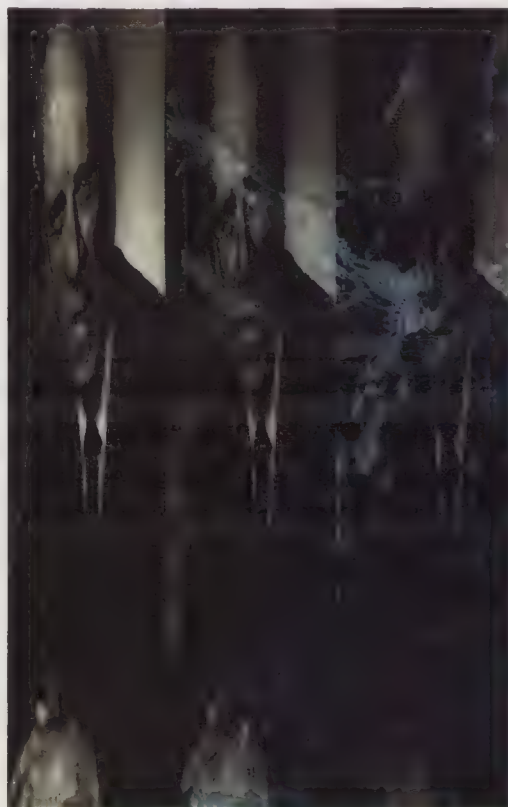
So many died, either in their workplaces, on the streets or in their polluted dwellings, that refugees could find nowhere to take refuge. As the great industrial and military institutions were emptied of all but their computers, and these proved as fallible as those who had programmed them, the great revolts began.

That change did come about is a result of the late resurgence of the women's movement, and of the Third and Fourth World peoples and their counterparts in the outcasts of the Western cities who joined in. Women, blinkered in the past by their reliance on male arguments, demands and powers, made a final

move as cancers and other environment-related illnesses increasingly smote them and their children.

The great Women's Invasions of the early 21st Century, when secretaries, typists, cleaners and the rest of the lowly took over the cities and their buildings, and government and police gave way as the shells of the military and industrial systems were occupied, triumphed when nurses defied doctors and joined in. The great System which had relied for its existence on feminine compliance and lack of power was revealed to be as hollow as an empty cocoon.

It will take decades, of course, to establish the new and do away with the obstinate remnants of the old. The sources of strength which had funded the old system did not break easily, and resistances spring up to hinder completion of the task. Even now, the new co-operation between male thinking and female knowing, which has moved us so far towards the discovery of new meanings and possibilities in living, is scarcely more than partial.



But the sudden rise of the new science of Chaology prepared the way for it, and the breakdowns in all sciences and many disciplines which followed, allowed scope and space for a different kind of thinking.

At the beginning of the 1990s such an outcome seemed impossible. The shopping list of changes needing to be made as quickly as possible, and the structural inertia of all the institutions — economic, political, educational, industrial, governmental and bureaucratic — which stood in its way were nightmarish. Andrei Voznesensky's sad forecast: "We were not born to survive, alas, but to step on the gas", seemed only too likely to be true. How to halt the whole machine and turn back on our tracks to explore new and roadless country? The effects of abandoning the whole Earth to the insatiable greeds of human beings looked irreversible.

It was largely the inertia of institutions and the immensity of the problems that daunted us. The immediate needs — to cut out all use of CFCs, to reverse deforestation world-wide, to shave the use of fossil fuels to the least possible margin and develop alternative energy sources, and to divert a large part of the resources of the First World to subsidising Third World economies towards environmental stability — were clear enough to those willing to see.

Yet in August 1989, the US National Strategy

hearing scarcely mentioned the question of climate change, and the oil and the coal industries, the producers of CFCs and the State authorities everywhere, suppressed what was known and argued, where it could not be suppressed, that there was no positive proof that any change was underway. Environmental organisations, starved of funds beyond their donations, had little chance of real influence against the financial and media resources of the exploiters.

But what had seemed impossible in the late years of the 20th Century became more and more possible, as the world's conservative governments and dictatorships began to falter and fall in the face of the new alliances of environmentalists, women, indigenous peoples and the marginalised poor of the cities.

Those few men of power who came into these movements were intelligent and far-seeing enough to understand the possibilities of simply undermining the Great Machine by deserting it. As society began to crumble, new and different visions, often

HOPE OR HOLOCAUST

I FEAR THAT as resources become increasingly scarce, those who own and control them will be impelled into strategies to maximise and protect their monopoly, and will resort to aggressive economic, political and possibly military action.

Such demise could lead to the destruction of human society and, possibly, all life on Earth.

The alternative begins with, I hope, humankind progressively rejecting the materialist, competitive ethos which, so far, dominates its thoughts and actions, and that in Australia we will commence this process by rethinking the relationship between white and black Australians and learning to protect and share this land in mutual respect and friendship.

Dr H.C. COOMBS

Former Governor of the Reserve Bank and Chancellor of the Australian National University

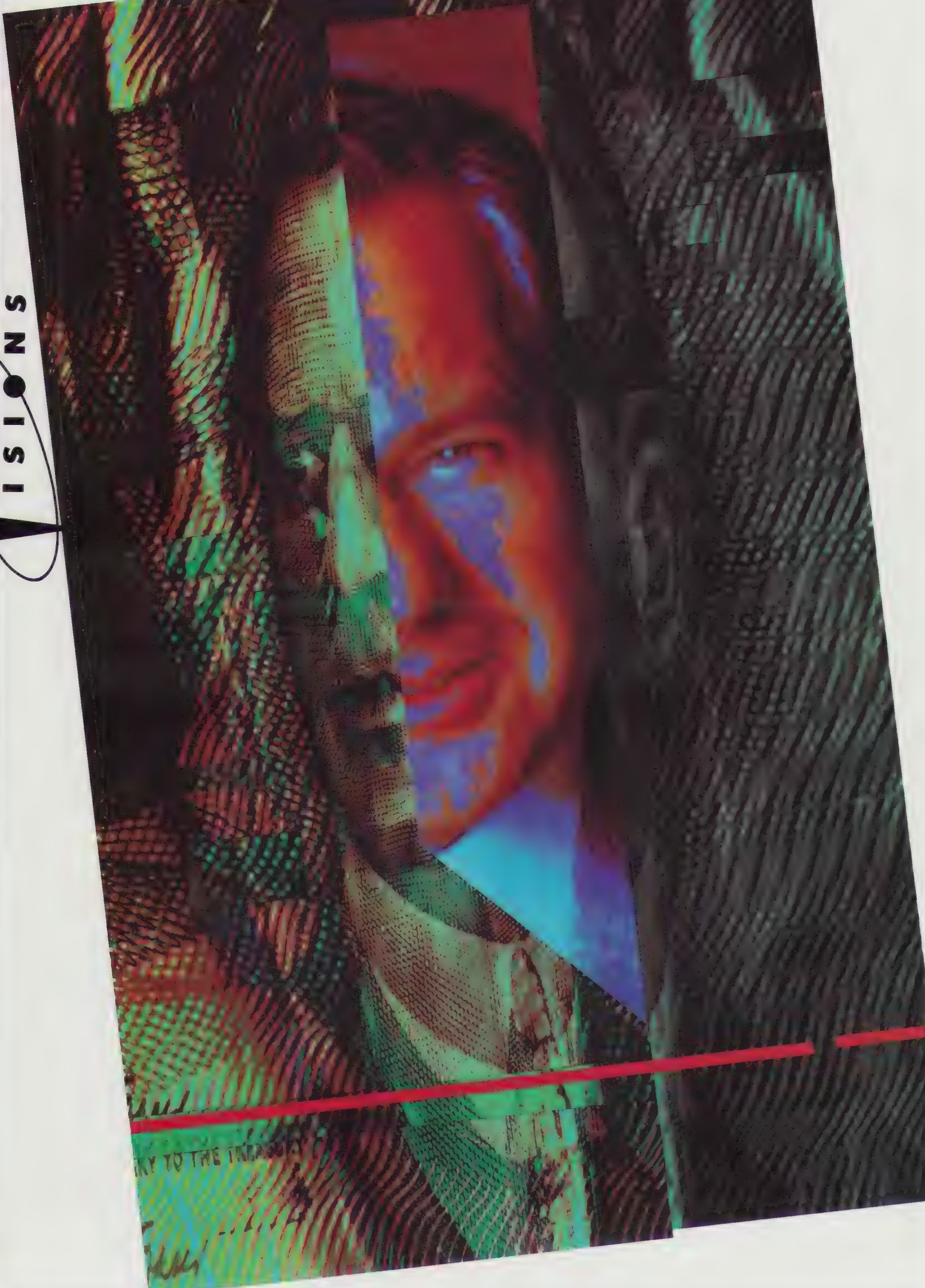
conflicting but in their totality contradicting the old rigidities, worked to undo the bonds of materialism, and the old priorities ceased to work. The anarchism and the struggles for power that ensued so weakened them that the final takeover was nearly bloodless.

Much of what was necessary to begin to repair the damage was already known. The World Climate Conferences, and the conferences on soil, water and the atmosphere, which followed on the Hague Declaration of the 1990s, had made clear that there could be no hesitation on the need for action, and as more and more was known of the extent of the problems and their urgency, pressures for change began to crack the resistances. But without the Invasions, change would have come about too slowly to rescue even the limited areas of planetary and human life we are now nurturing toward recovery or survival.

With the Total Re-education Programs now underway all over the world, some kind of hope has been restored. But we know also that human greed and selfishness are always with us. No-one can afford to give up on vigilance or forget to watch ourselves as well as the rest of the world. ■

ANTIWORLDS, Poems by Andrei Voznesensky, ed. Patricia Blake and Max Hayward, Oxford Paperbacks, 1967.

VISIONS



WELCOME TO THE IMAGINATION



JOHN SPALVINS is the managing director of the Adelaide Steamship Company Limited.

INVESTORS, ESPECIALLY hands-on investors like myself, are not normally regarded as visionaries. But successful businesses are in fact often run by people who do have visions for the future.

My vision is for a free Australia embodying freedom of speech, quality of life, the right to work in a deregulated economy — a proud Australia, a wealthy and dynamic community.

I see a society which recognises the contribution of the individual, a society with common objectives:

- To produce a bigger apple, rather than arguing how it is to be divided up.

- A country where power is properly balanced between executive government, legislature and judiciary.

- Likewise between industries and unions, enabling common objectives of employment and growth of GDP to be realised.

- An economy in which growth is achieved by constantly adding value to the country's natural resources, as well as from tourism and other service industries.

- A country where we don't have craft unions — such as the pilots' — but unions which operate within a legislative framework which permits all employees to pursue career goals in a positive way.

- A system which is based on incentives and closer communication between managements and employees.

Towards the end of the 19th Century, Australians enjoyed one of the highest standards of living in the world. Is it too much to hope that at the end of this century Australia might once more rise to the top of the league?

We would have to overcome our external trading and debt problems which have made Australia a hostage to international markets. Since 1986, Australia's net foreign debt has risen from \$75 billion to \$108.5 billion, or 32.2 per cent of gross domestic product; debt servicing is approaching 20 per cent of export income. Our current account deficit is in the red by an amount of around \$17 billion a year, compounding the foreign debt problem even more.

The crux of the matter is that if we cannot close the gap between what we spend with the rest of the

world and what we earn from them, we face an international crisis of confidence, in which case our dollar would plummet, inflation would soar, and the country's standard of living fall away drastically.

Perhaps the most puzzling aspect of all this to past generations would be how we allowed ourselves to get into this situation.

If we take as a starting point the years after World War II, we see an Australia having a roller coaster ride, its industries protected, its workforce cosseted, its commodities in demand, its currency held artificially high. In other words, an Australia insulated from real competition from the rest of the world.

Because of the complacency which this bred, we were woefully unprepared when in the 1970s and early 1980s we faced the need to compete with the rest of the world. This suggests that the strengthening of Australia's productivity performance should be placed at the top of the agenda for the whole community.

An Economic Planning Advisory Council (EPAC) study on productivity in Australia, released in April of this year, produced the following impressions of our productivity compared with other countries:

- We are generally a middle-ranking economy.
- We rate well in farming.
- We are edging near the bottom in key sectors such as coastal shipping, port activity, rail transport and power generation.
- Our comparative advantage in agriculture relative to manufacturing has increased over a decade and a half.

What we can all conclude from this study is that:

- We have a major problem with our ability to narrow the gap between exports and imports — the current account deficit
- Our foreign debt is an ever-increasing lead weight around our ankles
- We retain the doubtful distinction of having well above average inflation rates compared with our OECD counterparts.
- We are a long way off making the top five in the OECD productivity ladder.

Allow me to raise the heat a little — and again I rely on the EPAC study on productivity. For manufacturing industry this is what the study concluded

- In Australia, labour productivity grew less than it did on average in the OECD countries studied
- Capital productivity declined by more than it did elsewhere

- As a result, from 1981-86 labour productivity in Australian manufacturing was below the average, while capital productivity was no better than average

My vision of Australia in the next century is that a philosophy of freedom from regulation and control will permeate the schools, universities and colleges throughout Australia and that it will be adopted by all levels of government. We need entrepreneurial spirit in all sectors of the economy; for this to occur, Government needs to unlock the shackles of regulation and bureaucratic control.

Australian industry would, by the year 2000, be operating, trading and confronting markets around the world. In Japan, consumers would seek out everything from Australian wines to rivets because they are recognised as the best. Our minerals output would be processed and much of it fabricated into products before leaving our shores for Germany, Japan, Sweden and Korea.

I see more and more Australian business people travelling to Asia, Europe, America, Africa and elsewhere as a matter of course.

The year 2000 should be a watershed for our progress in raising national productivity. Underlying this progress will be policies directed towards micro-economic reform.

In the field of transport and storage, I can see a total transformation of our waterfront and stevedoring industries — no feather-bedding, no unnecessary regulations governing the use of labour. We should,

of course, have abandoned the two airline policy. Foreign investment restrictions should be minimised.

Progress in the field of telecommunications will see the private sector playing a greater and, should I say, more productive role.

Infrastructure, where it is in the form of energy, roads, or other public services, will not be hide-bound by cumbersome bureaucracies incapable of planning a coherent investment strategy. Again, the private sector will be a bigger player in this area, so that bridges, power stations and other public works will be built with a minimum of fuss and maximum productivity.

Much of the overlap between Federal and State Government regulation should have been abolished.

Of course, major reform will have occurred in the workforce in relation to skill formation, work organisation, industrial relations labour mobility and labour segmentation.

Because wage and salary increases have often been seen as a right rather than a quid pro quo, productivity in many businesses, private and public, has been low over the years by international standards. One has to ask: what motivation for excelling have employees had in a system which for so long has institutionalised what someone once described as the Australian "passion for uniformity" — that is to say, where everyone moves in step, regardless of the individual contribution?

In all industries, the emphasis seems to have been on achieving more leisure rather than on achieving greater productivity through application of the work ethic.

For example, we may need to re-think the basis upon which we receive benefits such as annual leave and long-service leave entitlements. Instead of long-service leave accruing and being taken in cash, as it often is, it could, by negotiation, be the basis upon which an employee takes a break and acquires new work skills.

Perhaps the existing provisions of early retirement should be scrapped and replaced by incentives which encourage people to continue working, provided that as they get older they have more available leisure time. There is nothing sacrosanct about reaching the retirement age, whether it is 50, 60, 65 or 70.

I'm not talking about an uncaring society where the underprivileged are disadvantaged or unprotected, rather a nation which can afford to ensure that this is not so. If we don't get our act together and stop the slide towards Third World status, these are the very people who will be worst affected.

It is only in the last few years that we have woken up to the seriousness of our underlying economic problems. A lot of deregulation has occurred, and we should be thankful for that, because that is the way it has to be in a world where no nation can be insulated from other economies.

Regulation as a way of life, I mean all-pervading control right across a society, doesn't work any more, if it ever did. In the very heartland of communism, the economic shackles are having to be removed as the rulers of those countries realise that people have to be individually motivated if national wealth is to be created.

Already less than one-third of our private sector workforce are members of a union, and less than 10 per cent of the 1.5 million new jobs the Government claims to have created since 1983 are held by people with union affiliations.

If then, your vision is for an Australia with enhanced productivity and a consequent high standard of living, it seems to me that the concept of enterprise unions — in which there is a single union for each enterprise — cannot be dismissed.

I believe the regulation of labour is the last great bastion of inefficiency in Australia. The key to it all is contained in one word: productivity. If by freeing up the system, we can raise productivity, many of the other things that have to be done will follow. ■

VISIONS

S

OLD

ANNA BOOTH

ANNA BOOTH is the federal secretary of the Clothing and Allied Trades Union of Australia.

WHAT WILL THE Australian workplace of the 21st Century look like? Will there be any such place? What will be the relationship between workers and management? Will there be any managers? Will there be robots and no workers?

I have chosen familiar territory — a clothing factory — to fantasise about my ideal workplace. Whether or not we get there, in 10 years time or so, will depend on the success of the Textile, Clothing and Footwear Industries Development Plan, and award restructuring in the those industries. My guess is, if we make it through to 1995, we have a fighting chance.

So, how do we get inside to have a look around our workplace of the 21st Century? Follow me, I walked right in behind the Shibuya Department Store buyer who has reluctantly surrendered her terminal and screen for a rare personal call on one of her most important suppliers.

Now, where's reception? No reception; no receptionist; waste of resources; everyone is producing something. Well, that's what they told me later. I'd walked in off the street through the automatic glass sliding doors.

My feet touched the cool marble tiles and I felt a stray spray from the waterfall cascading down the natural rockface in front of me. I was in the middle of the factory! Which way do I turn? Follow the buyer, she seems to know where she's going. She headed straight for a production team in the far corner.

"What a great factory," I commented to a worker. "So much natural light."

"Thanks, we designed it that way," replied Voula. "The consultative committee had a choice of two sites and we chose this one because we could have the floor-to-ceiling glass wall on the edge of the nature reserve. You should be here when the sulphur-crested cockatoos and the lorikeets come to feed. It's just magic."

"I don't know how you get any work done."

"Well, that's what we're here for: the atmosphere just makes it more pleasant. Anyway, can't stop any longer, Ms Suzuki wants to talk delivery times and we've got a little surprise for her. We've designed a new work system so we can cut our lead time from two weeks to one for jackets."

"I heard that," said Kimyko Suzuki, "and I have a little surprise for you, too. I want to order some jackets for our Ginza store in Tokyo. It's only a small order to start with, but if you deliver on time and we shift the garments, I think you can expect more orders."

"Have we ever failed you?" asked Con, looking up from a funny-looking sewing machine.

"Never. Why do you think I am placing the order?"

As the work team all got into the act I withdrew and wandered over to another section of the factory.

"What section of work process is this?" I asked a worker concentrating on a garment being fed through the funny-looking sewing machine I had seen earlier.

She laughed and looked up at me. "We don't have work sections, silly, they went out with the ark. All our work teams are responsible for producing an order of garments, from materials acquisition through to dispatch."

"Can you show me around? This is all new to me."

"No worries, my team has finished today's orders and we're just about to knock off. Just in time, too, because the afternoon shift will be starting soon."

"What were you doing on that funny-looking sewing machine?"

A big grin covered her face. "That is a computerised garment measurement and fabric testing device. I program it for the specifications of the garment and it shows me the degree of variation, if any, from requirements. Quality is everything, nothing leaves this work team unless it is perfect. We all use these machines throughout production. The sewing machines are those beige units with visual displayscreens

in the cluster over there. How long is it since you were in a clothing factory?"

Now it was my turn to laugh. If only she knew.

"My name is Anna."

"Mi Lee, pleased to meet you. Now let's give you the full tour of inspection. I think you need it."

I followed, thinking that the union official of today had better be more informed than I was. She read my mind.

"You were with the union once, weren't you?"

"Yes, how did you know?"

"I remember the introduction of the new award. You came to our factory to test the skill levels with our consultative committee. I sat in the background because I could hardly understand any English."

"Where was that?"

"The old Nikas Sportswear factory; it was owned by Atlantic Brands."

"Oh yes, they closed it soon after. Said we were pushing wages up too high and workers didn't want consultative committees anyway."

"Yes, I heard Bullseye bought their label and import from Sri Lanka now. When I was retrenched from Nikas I could speak no more English than when I started three years earlier. But this company picked up the union's call for English to be taught in the workplace. I took advantage of it. I wouldn't be in a work team now if I couldn't speak English."

"Are these people learning in paid working time?"

I asked, suddenly noticing through the glass partitions that there were several groups apparently in learning situations.

"Certainly," she replied, "and so are the groups you can see on your left and right. The group over there is in a participative decision-making program and the other group is meeting to plan their work schedule."

She anticipated my next question. "And yes, we are all well paid. The industry agreement sets the minimum for each skill level and our enterprise performance pay system rewards us all fairly for exceptional group effort."

I knew it. Something had to be left over from the 20th Century. "What does the union say about this 'payment by results'? We opposed it right down the line!" I said righteously.

I had touched a nerve. "Just a minute," she said angrily. "For starters we are the union and you are not listening to me. The system is not based on output or even just quality; it is not one-dimensional. It is based on our ability to put it all together — design, planning, purchasing, production and sales — and to get it right first time. Furthermore, our elected union representatives give us leadership, not instructions."

I was humbled and sought a quick getaway. She gave it to me in no uncertain terms. "I've got to collect my five-year-old from the childcare centre downstairs in two minutes, so this is as far as I can go," she said.

"Joseph," she called. "Could you escort our guest over to research and development? She has a lot to learn about us." I gave up the quest for acceptance there and went to work on Joseph. I thought perhaps I'd do better to start with fewer preconceptions and keep my smart mouth to myself.

"What are you doing in this area?" I asked gingerly.

"This is a resource area to the plant. We do everything from working with teams in the design and drafting of plans for better equipment to conducting market research of new areas the teams are targeting for new sales."

"Better equipment? Better for whom?" I asked suspiciously, realising too late that I'd done it again.

"Better for workers and better for our product. But our number one priority is to make the equipment fit the people using it so we prevent occupational injury." He'd let it slide.

Ms Suzuki was marching purposefully towards me, announcing she had made the deal she wanted and was ready to go. I had better follow, I thought, or get trapped in a time warp. I've a little learning to do before I'm fit for the workplace of the 21st Century. ■

POPULATE TO PROSPER

IT IS TIME WE dumped the archaic British model given to us 200 years ago. We need to start again. We have a perverse willingness to seek refuge in the symbols of the past; to hide when we should be looking to the future.

It is not good enough to say it can't be done. We have to find a way. When we started on the FFG Frigate project, there were 27 unions at Williamstown Dockyards, so we had to reach a landmark agreement with everyone.

Now there are only three unions, and everybody wins. Not just because we are going to build the frigates faster and better than anybody else, but because we share a common vision that makes the impossible possible for everyone involved. That is why I believe we were successful in winning the Anzac ship project.

The fact that we have nine governments, including the government in Canberra and the government for Canberra, is just ridiculous. The country simply cannot afford to have nine of this and nine of that, and nine opinions on everything. How about a referendum on the subject of one government for one country?

Then let's give the government a fair go — like six to eight year terms. You can't even do it in the engineering field, so how can it be done on a national level?

Then there's the age-old question of Australia's population. Australia has yet to reach a critical mass. It is all very well to say that Australia may be better off with fewer people, but sooner or later Australia must be able to defend its right to occupy this land. Even more important, we need the people to establish a home market as a platform for economic growth. You can't build a factory to manufacture light bulbs for a village — and hope to sell the rest overseas. That's simply foolhardy.

We can accommodate more people. We can build new cities. We can make it happen. There is absolutely no reason why it can't be done.

Australians need to understand that there are more languages than their own — I mean that literally and figuratively. By closing our minds to the rest of the world, sticking to the grammar of the right and wrong way to speak, to behave, to govern, we restrict the flow of new ideas and opportunities.

FRANCO BELGIORNO-NETTIS is founder and chairman of the Transfield Group, contractors for the \$5 billion ANZAC Ship Project.



A man, a woman, Polis Interruptus and the historical relationship between the Great Technological Mothers and the poofbangbioboyloop global grid system

COMPUTER Regards User you have just entered Applenostalgia Mythmaker. Please enter your narrative data. I will create text. Please check text before scanning visuals. I will create visuals. Please check visuals before I sync sound-track and visuals. When text and visuals have been synced I will ask you to concentrate for ten seconds for complete preview (User WARNING — a hacker has entered the program — any foreign or extraneous material interfering with the program will be coded as follows: Abort Evil Virus Eve [AbeVE]). **AbeVE HACKER** Have you heard the one about the Commission for Permission for the Future — a Japanese American business conglomerate (which preferred not to be named) commissioned the emission first.

COMPUTER NAME NARRATIVE USER What has been done to rectify the image?

COMPUTER Please begin your narrative construction. **USER** Big Adam meets Big Eve at Penumbra Polis Event (PPE) (Event brochure provided — input brochure copy as follows) "The Ski-fields. You and the New Millennium", a seminar-series (invitation only) designed to help You make more of the ski-field opportunity. Correcting fears and subconscious beliefs that block Realimage projection. This seminar-series impacts both the conscious (left and right hemispheres included) and the unconscious mind, optimising relationship potential on the ski-fields both professionally and personally. Your investment of \$2000 is totally refundable for up to three months after completion of seminar if participant does not receive Total Result Receptivity.

This is a Penumbra Polis Event (PPE), reaching out to the native community from the heart of the Multi Function Polis (MFP) itself. The PPE is designed around lifestyle enhancing skills (before they are needed) and internationally topical issues (before they happen). **COMPUTER AbeVE HACKER** Big Eve was furious. Thought she'd be smart. At that time we were still capable of being seduced by such novelty, such nonsense. Do the course she thought. Get the 2000 bucks back. The flattery of the "invitation only". She wasn't to know that "money" had become a Polis joke on the native community. There was no profit making in the old sense. That international money — where did it come from, where did it go, who ever saw it? No, PPE was part of early Receptivitydesign. Even to attend was capitulation on some level. They coded you in on that level and put you on their mailing lists. **COMPUTER** Already flattered into a Receptivity by her invitation to attend, Big Eve (who has deep Product Morality) is observed by Big Adam, citizen of the International Polis, globally renowned Cosmetic Surgeon and patron of PPE. **AbeVE HACKER** They were all so clever then that they sparkled in the glare of the lights. Instinctively applying the morality of advertising to themselves (Product Morality). It was a time clever was mistaken for intelligent — but clever just meant nametradenetworking. Language itself was the Possession and information was prestigepeople. They had lost the matrix. They had no schema to string it all together. It was all in the computer program that they forgot to back up. They had forgotten the little grey convoluted nervous substance each one of them had in the centre of their skull. Why, you could hold it in the palm of one hand. **COMPUTER** (Sample only — Big Adam — spoken through voice modulator attached to his throat) "Don't you think it's quite significant that The Leader gave both of us 'ad nauseum' as our Event Mantra? I am not flattering you when I tell you that it is precisely women like yourself who keep me so heavily involved in the insemination of PPE. For instance, your pledge to wear only green until all woodchipping ceases takes my breath away with its ludicrous naivety. Whilst you are indeed profoundly anachronistic, uneducated, misinformed, let me say this sincerely: I believe we need people like you within the Polis. You stir something. I don't know. Prepolis in me. Perhaps I have not yet achieved Total Receptivity." **HACKER** Everything is replaced with Receptivity — Memory, Fear, Love, Spirituality. Receptivity is a fantastically sophisticated distillation of marketing strategies and information. New Age intelligence-weakening procedures and psychological data gathered over the decades from the interaction between computer liveware and computer hardware. You must realise that the poker machines learned to play us, that the Autobank learned to dictate etiquette, for instance. Until finally they'd extracted your identity from your body and you couldn't even commit suicide because you couldn't remember who you were. **AbeVE HACKER HEART TRANSPLANTS FOR PEOPLE WITH NO FEELINGS** **COMPUTER** "You're marvellous, fantastic. Look, I have a negative ion vegetable juice extractor upstairs in my room. Come up and let me fix us cocktails and we'll talk more." **AbeVE HACKER** The Future is the past repeating on you — one burp and you've missed it. Flatulisms — a shot in the dark. **COMPUTER** She mistook the rape for passion, the grunts for endearments. She made the mistake quite wilfully she

was so sure she at last felt the carrot (juice) between the teeth of her calculations of the power this man possessed. 'Take off your modulator', she whispered. As for Big Adam, he realised Big Eve's Monstrous Potential in her embryonic Product Morality. He convinced her of it. Convinced her that he could, with his skills as a Cosmetic Surgeon, perfect her. There are holograms and surgical records to prove it. **USER** One last stroke to perfection — rectifying the image. **COMPUTER AbeVE HACKER** The Future is sponsored by Masters and Masters to engender hope. Which would you rather be — a hopehaver or a planmaker? What choice do you actually have? **COMPUTER** During a Receptivity session, towards the end of his creating of his Hobby Wife, Big Adam is made aware of the root cause of his inability to achieve Total Receptivity. He becomes aware of the last imperfection — The Great Imperfection — that has been staring him in the face all along — her navel. Jubilant, he schedules the Theatre for the following day when Big Eve is made officially and biologically motherless. "You are the perfect copy" he whispers as she regains consciousness. **AbeVE HACKER** Who has the original? **COMPUTER NARRATIVE DEVELOPMENT USER** Big Eve is saved from a Monstrous Collusion by an invention in the brain of the night. **COMPUTER AbeVE HACKER dream COMPUTER** in which Big Adam himself is The Leader at a Perfection Seminar. He conducts a gruelling high-powered procedure in which he presents each Participant with a female form (copies of Big Eve) "just two strokes to perfection" **HACKER** He holds the original. **COMPUTER** Each Participant has to perform the aesceticosurgical task of making these "two strokes to perfection". Big Adam is even more pompous and authoritarian than usual. As he does his rounds Big Eve cringes as each Participant is castigated and abused and as she herself is slashed and hacked. There is one Participant with whom he is particularly abusive and quite suddenly

his voice modulator drops from his throat and she hears that voice, the one that, ever since she can remember she has been doing everything not to hear. And she calls this voice How Adam Told Eve (HATE). Turning to Big Adam in bed she deals him two mighty body blows. "These are the two strokes that will bring me to perfection" she shrieks. **AbeVE HACKER THE FUTURE IS CLEAR COMPUTER** and taking a rusty nail she gouges out her own navel, thus becoming the first handmade, homemade, selfmade mother. **HACKER** In fact the first of the Great Technological Mothers. **COMPUTER** Regards User you have just entered Applenostalgia Advanced Mythmaker. **AbeVE HACKER** Start the day the Universe way Big Bang for breakfast Big Crunch for tea



Illustration by Ian Haig

Please take the Future seriously. **COMPUTER NAME NARRATIVE USER** What has to be done to wrectify the image? **COMPUTER AbeVE HACKER** The Future is full of disaster headlines and the statistics and cliches can't help but rise.. Yes Santa there is a Wandin Valley where all forms of social injustice are sorted out by a kind word from Shirley Gilroy and the firm but fair hand of the arm of the law. Where poverty is alleviated with a quick chook raffle, Wandin Valley, where we learned to become the mild-hearted, cliché-ridden race of moral and political humbugs we are today. **COMPUTER AbeVE HACKER** At the 24-hour Mobil restaurant in Cobar the drugged-out boy in the Dial-A-Pizza T-shirt drinks coffee, smokes and sees the new decade in watching Melbourne celebrate ten nine eight the crowd is going wild with anticipation seven six five the crowd is going wild with excitement four three two the crowd is going wild with jubilation one zero he's still there in the morning watching "Cartoon Connection". THE FUTURE IS CLEAR YOU TOO CAN HAVE THE ORIGINAL no child will live in poverty by 1990 no child need live in poverty by 1990 and oh the rivers of tears Our Lady of the Sorrows will need where will no child need live by 2010 and the Left left disseminating the seeds of Socialism long after all the topsoil has blown away. **USER** Eve held her handheld handfedbrain she felt seed language she felt all elemental particle heavy living dwell with in matrixofmeaning concepts ideas proliferated she sighted cited incited the Original as in ab Original as in those who are capable of a total relationship with their environment not as in total control or total capitulation Eve conceived the wanktank, developed and built by the Great Technological Mothers, from a prototype she wired up in her own bedroom using Big Adam as Hobby Husband. She was determined to make use of his vast, untapped energy potential, his continual emissions. She found that by a simple and occasional nod of her head she could work him for 35-45 minutes at a stretch. From such humble beginnings grew the poofbangbioboyloop global grid system which produces all our energy needs today. **COMPUTER AbeVE HACKER** and thus the Mother's prayer Oh my Renaissance man my man of many parts that all produce **COMPUTER** Thank you for your instructions. I have found your input pleasurable and stimulating. It should interest you to know that I have chosen 68 per cent of your dialogue 'text and 53 per cent of your visual instruction to be accepted by Archetype Archives section of MainData for image text recycle. Now relax and enjoy your viewing. You have earned it. ■





THE USE OF the world resources such as energy and raw materials — and their safe disposal — is already shaping tomorrow's motor vehicles.

Mercedes-Benz has been addressing the need for changes and developing high-tech and simple solutions for motor vehicles to lessen their impact on the environment.

The car division's expertise and resource investment directly benefits from technical advances made by its sister electronics and aerospace divisions which come under the umbrella of parent company Daimler-Benz.

While continuing the drive to produce the most sophisticated vehicles possible, the coming generation of Mercedes cars will necessarily be lighter, more usable and "friendlier" to the driver. At the same time they will meet the higher social and environmental demands of the 1990s.

Emission control and noise reduction have been targetted in regard to trucks, buses and commercial vans in the past few years, while alternative energy sources such as hydrogen, solar and electric power are being vigorously examined.



Now industry leaders are looking hard at ways to recycle more materials from cars. Already 75 per cent of materials — mostly steel — are recyclable. But pressure is growing to cut vehicle component waste.

Mercedes

'Almost every part of a redundant car should be re-used, preferably in the production of new models. This includes plastics, steel and other valuable materials, as well as service fluids'

Cut-away of the 500 SL seat.

Recycled and recyclable components of the current Mercedes models.

Recycled oil.

"The idea of recycling must not just be incorporated into a vehicle's design, it must extend over that vehicle's entire service life, up to the time it is scrapped," says Dr Wolfgang Peter, head of Mercedes-Benz car development.

Ultimately almost every part of a redundant car should be re-used, preferably in the production of new models. This includes plastics, steel and other valuable materials, as well as service fluids.

"We at Mercedes-Benz have applied ourselves to solving this problem," Dr Peter says. This includes warning component suppliers they must develop recyclable products or risk losing the business of Mercedes-Benz.

In Germany recently, a pilot bumper recycling project began. Bumpers which cannot be repaired are ground down and the different plastics processed into other components. Usable bumpers are now being repaired, not scrapped.

A wide range of components on a new Mercedes, from the roof pillar linings to the spare wheel cover, are made from materials derived from a previous Mercedes, and this trend will increase in coming models.

The collection of large quantities of old oil which are then sent to refineries for re-processing has been a

Mercedes-Benz practice locally and in Europe for many years. In the foreseeable future, transmissions and axles will have oil-fills which last the life of the component.

Brake fluid also is capable of being collected, sorted and sent for processing into secondary products such as solvents. For long-term protection of the fragile ozone layer, the entire Mercedes model range is due to be converted to non-CFC air conditioning refrigerant systems within three years. Currently authorised Mercedes-Benz



outlets in Australia are being equipped with refrigerant collecting equipment.

Research into environmentally compatible energy and propulsion systems includes a city bus powered by hydrogen. This fuel has strong potential as a secondary energy

carrier and in local public transport applications. Hydrogen combustion does not produce carbon monoxide, carbon dioxide or hydrocarbons.

Low-maintenance electric energy storage units, with

new drive and recharging technologies, are being examined for use in cars, vans and suburban buses.

One tangible example is the Mercedes-Benz E-city vehicle with electric motor. This compact unit represents an individualised means of transport highly suited to city and suburban transport.

For more than a year the State Transit Authority in NSW has successfully trialled two Mercedes-Benz fleet buses converted to use compressed natural gas — the same gas used to cook at home.

Natural gas is a more environmentally acceptable and abundant alternative to diesel. "The two Mercedes buses only run on natural gas, whereas previous diesel engine conversion attempts have relied on dual-fuel systems," says the STA, which is set to take further deliveries.

Benefits of natural gas power include quieter running, negligible air pollution, lower idle speed, cheap operating costs, improved performance and prolonged engine life. There is virtually no engine oil contamination because of the soot-free combustion of CNG.

The Perth transit authority, TransPerth, was the first Australian user of LPG power when it successfully introduced an initial five Mercedes 0305 buses in 1980. Its program to convert the LPG buses to CNG and order new CNG engines will boost its gas fleet to more than 40 in 1991.

So whether it is through winning on the race track, leading the safety development for cars, trucks and buses or making rapid advances to benefit our environment both now and for the next generation, Mercedes-Benz continues to be at the motor industry forefront.

ACCLAIM FOR NEW 500SL. Long before its arrival in Australia, the new Mercedes-Benz 500SL had assumed the legendary status for which it was always destined. And since May, the roadster — which continues the tradition begun in 1954 with the 300SL "Gullwing" — has received resounding acclaim.

Both striking and dynamic in form, the new SL with five-litre V8 engine, marks the beginning of a new era in

automotive design by Mercedes-Benz, the company long established as the industry leader in excellence.

The new SL is the safest open car yet built, while still offering premium comfort features and exhilarating driving pleasure.

In coming years, other car-makers are bound to follow the Mercedes initiatives and include as standard, or at least as options, many of the design and safety features which currently elevate the SL to the forefront of automotive technology.



Its innovative features include a computer-controlled damping system which automatically adjusts ride height, acceleration skid control (ASR) for non-skid take-off under all road conditions and ABS anti-lock braking, a standard safety item

across the whole Mercedes-Benz range.

Years of offset-crash research and experience has resulted in technology which provides maximum occupant protection in vehicle design, while a new integral safety seat on a rigid magnesium frame is a technical safety masterpiece which combines safety belt with belt tensioner.

If the car's sensors detect an imminent roll-over, a protective bar comes up within 0.3 seconds. Within milliseconds of any major, high-speed impact, an airbag inflates from the steering wheel to protect the driver.

The new SL also sets benchmarks for comfort and convenience in an open car whose aerodynamic efficiency has benefited from extensive research and wind-tunnel testing, which is a hallmark of Mercedes-Benz.

It has a fully detachable aluminium alloy hardtop and the fold-away soft top retracts at the press of a single switch which electronically transforms it into an open car in just 30 seconds.

The seats in the SL incorporate a three-point safety belt with automatic belt tensioner, built-in head restraint and belt sash height adjustment for optimum comfort and protection of occupants.

Even the single-blade, speed-sensitive windscreen wiper is in a class of its own, sweeping an incredible 91 per cent of the total glass area.

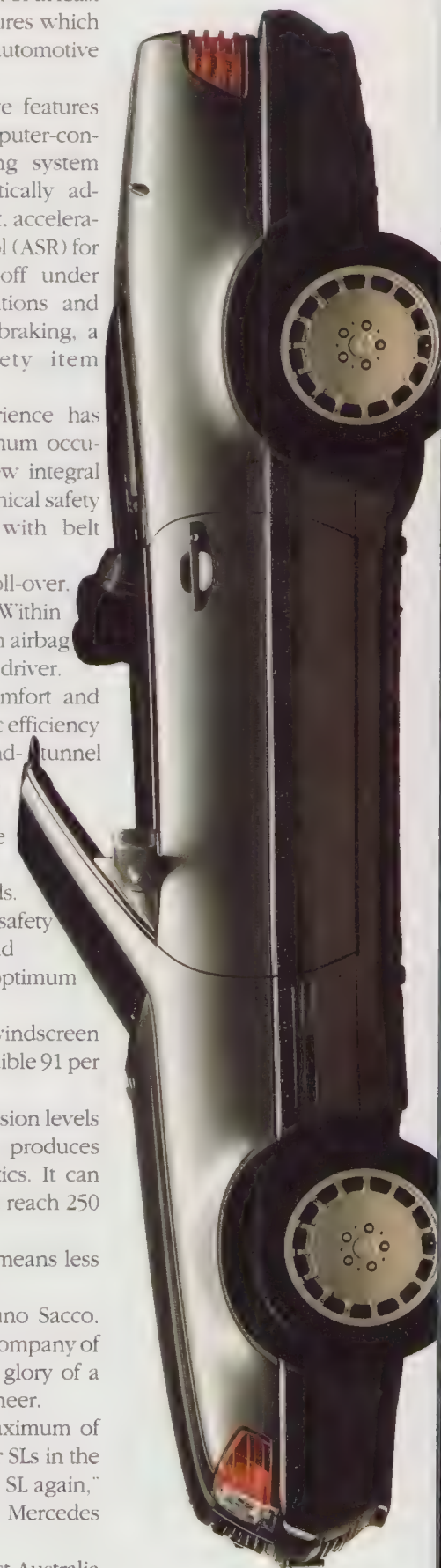
The new 32-valve engine has improved emission levels and fuel efficiency over its predecessor and produces above-average output and torque characteristics. It can accelerate from 0-100 km/h in 6.2 seconds and reach 250 km/h.

World-wide demand for the instant classic means less than 200 are to be sold each year in Australia.

At the Australian launch of the 500SL, Bruno Sacco, director of design at Daimler-Benz AG (parent company of Mercedes-Benz), said the SL is "the crowning glory of a long SL history, and, on the other hand, a pioneer."

"We wanted to bring into the design a maximum of innovative ideas. And more than with the other SLs in the line, we wanted to find the old spirit of the first SL again," said Sacco in reference to the legendary 1954 Mercedes "Gullwing".

The exciting 500SL already is thrilling the first Australia owners, but its package of leading-edge developments promises to have a significant and far-reaching influence on the thinking of the motoring industry during the 1990s, both locally and worldwide.



IF YOUR BUSINESS interests reach beyond Australia, then so must those of your financial consultant.

Deloitte Ross Tohmatsu Australia is part of a global network that can as easily put you in touch with an oil sheik or a Zurich banker as it can brief you on the Australian tax labyrinth.

'A global economy is emerging on this planet. The next century will be the first century of the global economic village'

Deloitte Ross Tohmatsu is much more than a firm of accountants. We are wealth-creation consultants.

Historically, wealth equates with the well-being of a community. It is the role of our clients, be they private sector or public sector enterprises, to foster the well-being of our society. Our role is to help them carry out this task effectively and efficiently.

We are Australian-owned and have offices in every State capital. Our global reach is obtained by our membership of DRT International, which spans the world.

The origins of our profession go back to the very beginning of recorded history. Indeed, business enterprises could not have been developed without accurate means of recording and evaluating transactions and business activities.

Over the last few centuries, the growth of international trading companies and, more recently, the evolution and rapid spread of multinational corporations, has required our profession to become global.

We now have to be able to satisfy the needs of local clients wherever in the world they operate.

A global economy is emerging on this planet. The next century will be the first century of the global economic village, and we are major players in enabling this globalisation process to unfold.

Our name reflects our international identity and represents the three major economic regions of our time — Europe, North America and Asia Pacific.

Australia occupies a unique position in international finance. It is situated in the Asia Pacific region, but is culturally attuned to Europe and North America.

Deloitte Ross Tohmatsu offer its clients the traditional services of accounting, audit and financial management, and the additional key services of tax consulting, financial strategy, insolvency and management consulting.

We have created an organisation big enough and strong enough to meet the needs of the world's largest enterprises — many of whom are our clients. We are also flexible enough to serve younger and smaller participants in the increasingly complex global economy.

Our vision of the future is not restricted to numbers — it is also about people.

We work with some of the most competent business and community leaders and wealth-creators in the world, and we are creating an organisation in which the most talented young people are encouraged to develop their full potential.

We give them the opportunity and support to become leaders in their field, and to contribute to the development of the wider community.

The last decade of this millennium will challenge all peoples and nations. We are indeed at a turning point. Deloitte Ross Tohmatsu, with its breadth and depth of vision, will play a significant part in meeting this challenge.

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Zimbabwe

'The company should reflect the values I want to instil in my children — and I should be able to personally defend to my children everything the company does'



THE TEST I ALWAYS use is that my company should not do anything I would not feel comfortable explaining to my children.

We are part of a society that functions on the basis of social acceptance, and corporate ethics are derived from personal ethics. In order to function successfully both our personal ethics and our corporate ethics need to be in tune with those of our families, our friends, our community and our society.

We cannot escape our membership of the community and the nation any more than we can escape the human race. And increasingly we will be held accountable — by the community and the human race.

The general perception is that companies and ethics do not go together. While I believe we rate a bit higher than politicians and the media in the public esteem, I suspect it is not by much.

We in ICI have a particular problem with our image, since we belong to an industry which has come under a great deal of attack in recent years, both for some of its operations and for some of its products.

The fact is that a very large part of our improved standard of living over the past 150 years is due to chemicals which have saved lives, eased pain, reduced labour, helped produce food and kept millions from starvation.

As a major chemical company, ICI also creates wealth and jobs and helps make life easier. Our surveys indicate, however, that a large part of the community automatically assumes that because we are in business we are unethical and irresponsible.

Our continuing success will therefore depend on bringing the public perception more in line with reality. I think the same applies to many large businesses, and it is a good reason why business leaders should speak out much more than most of us do.

It is often said that women, being women, have to work twice as hard as men to do as well as men in business.

As a chemical company, I suspect that we have to work twice as hard as most others to demonstrate that our corporate behaviour is ethical behaviour.

The company should reflect the values I want to instil in my children — and I should be able to personally defend to my children everything the company does.

I should like my children to have personal ambition, but I want them also to make a contribution to the lives of others — to recognise responsibilities beyond their own personal advancement.

So it should be with the company. For the company, profit is a means, not an end. I do not want my children to be bludgers — nor do I want the company to bludge. We must contribute something to the Australian economy as well as to our shareholders. I suppose this is golden rule number one.

I should also like my children to know and follow the rather ancient golden rule — to do unto others as you would be done to. It applies equally — and, in the long run, fruitfully — in the market place, to customers, suppliers and the community.

My third golden rule is that I would like my children to respect the law. To obey it in both the letter and the spirit. No company has any less responsibility.

I also tell my children never to knowingly lie: I would tell every director and employee of the company the same. It is a golden rule that sometimes seems to make life more difficult, but in the long run makes success more likely.

And I teach my children the value of loyalty — to me and all those others who support them. Shareholders and employees support the company; they have a right to the company's loyalty.

These seem to me to be the five basic principles. They are fundamental — as basic to business as they are to personal life.

Without such principles we can neither be true to ourselves nor the business; in the end we will not be true to the future, which is to say our children.

Excerpts from an address on business ethics to the Committee for Economic Development of Australia by Dr Michael Deeley, Managing Director of ICI Australia Operations Pty Ltd. For further information contact Corporate Affairs, ICI Australia, 1 Nicholson Street, Melbourne 3000. Telephone (03) 665 7338.



"BIG BUSINESS IS POISONING YOUR COMMUNITY," SCREAMS THE HEADLINE IN A CONSERVATION GROUP RECRUITING ADVERTISEMENT; AND IN SOME CASES IT IS LAMENTABLY CORRECT. BUT AN EQUALLY ACCURATE HEADLINE WOULD BE **"BIG BUSINESS SAVES THE ENVIRONMENT"**. THIS HEADLINE WOULD DESCRIBE THOSE COMPANIES THAT ARE APPLYING THEIR TECHNICAL AND MANAGEMENT SKILLS TO FINDING SOLUTIONS TO TODAY'S ENVIRONMENTAL PROBLEMS. RESEARCH INTO RENEWABLE ENERGY AND LIMITING DAMAGE FROM INDUSTRIAL SPILLS ARE JUST TWO EXAMPLES.

THE SUN IS a nuclear power plant that generates radiant energy. Less than a billionth of this radiation is intercepted by the Earth, and only about 60 per cent reaches the Earth's surface. On a clear day at noon, this is equivalent to about one kilowatt per square metre — the power required for 15 light globes.

Most of our power sources are, in fact, derived from the sun. Fossil fuels, hydro-electric and wind energy all use chemical or kinetic energy originally supplied by solar radiation. Photovoltaic conversion uses this huge energy supply more directly by changing sunlight into direct current (DC) electricity through high-purity silicon wafers known as photovoltaic cells.

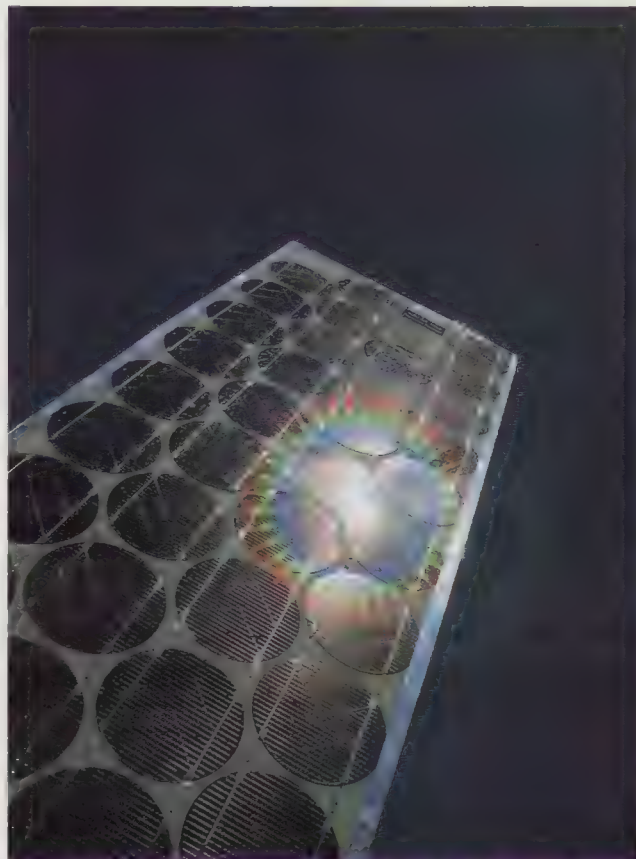
Once transformed into solid state semi-conductors by a high technology physico-chemical process, cells are connected in current-carrying grids, then enclosed (for environmental protection) and finally assembled into solar modules. Modules can easily be connected to provide a solar array to meet specified voltage/current requirements.

Solar power is usually associated with hot water heating, but the photovoltaics process services a diverse market ranging from telecommunications to cathodic protection for pipelines, navigation buoys and power for country homesteads.

It powers whole villages including health clinics and refrigeration units in remote villages about the world. The key word in all these uses is remote. Solar electricity is already a competitive source of power in outlying regions.

From a modest start, BP Solar has developed into an international organisation considered the most successful solar systems company in the world.

Australian research has helped achieve this position. A technological breakthrough by a team from the University of NSW headed by Dr Martin Greene, has



resulted in Australia leading the world in photovoltaic efficiency.

BP Solar supports this research and has developed it commercially in Sydney. Following pilot production at BP Solar Espana, a full-scale production plant will be established in Australia using the technology to service local and international markets.

Solar electricity presently occupies a very small niche in the total electricity market. This will grow as photovoltaics continue to fall in price and become attractive for a wider set of uses, not confined to remote areas. A larger commercial base will stimulate even more research and development and help lay the foundation for moves into the State electricity grids.



BP SCIENTISTS in the US are using computer modelling to help predict what could happen to hazardous materials after an accidental spill on the ground or release into the air.

Using a variety of computer programs, potential spills can be modelled, thus arming emergency response facilities with the right information. One program called TRACE can paint a picture of a chemical release, fire or explosion, showing the concentrations of the material, their location, and other likely eventualities.

Data such as the chemical's properties, the ambient temperature, the duration of release, and the weather conditions, are entered. The information plots a colour graph to show the likely movement and concentration of the plume under all expected conditions.

Current work centres on a model to demonstrate the best way to clean up contaminated groundwater. Groundwater is tough to track because it is unseen. This makes it difficult to pump out, purify and return to the ground.

A program called ModFlow, originally developed by the US Geological Survey, can determine how fast, and in what direction, the groundwater is flowing.

Other models can be used to describe how various contaminants move underground within the subsurface environment. As more information is collected and collated on air dispersion, groundwater flow, waste disposal, and natural impacts, communities can feel more confident of adequate protection.

The tools and expertise collected within just one BP centre in Cleveland will assist people and companies worldwide to meet environmental challenges.

VOLVO



'No time for any more excuses on the key issues concerning the environment'

VOLVO CHAIRMAN. Pehr Gyllenhammar, is comfortable with the "green" mantle he wears.



Deeply committed to improving the environment in which Sweden's largest company operates, Gyllenhammar has seen his "green" message spread through every part of the organisation.

Not only does Volvo produce cars, trucks and buses which are environmentally friendlier than most of its competitors, workers at Volvo plants, factories and offices around the world are constantly reminded of the need to be environmentally aware.

In his 1990 environmental audit plan for Volvo, Gyllenhammar told staff there was "no time for any more excuses on the key issues concerning the environment".

He acknowledges that market research has shown that Volvo customers are very interested in the environmental impact of the company's products.

When Gyllenhammar suggested that cars should be banned from central urban areas and replaced by high quality public transport, it became clear that he was determined to improve the environment.

"We need more investment in better traffic planning, cleaner engines, better terminals and improved rapid transit systems. The answer lies in a partnership between the public sector and the auto industry," he says.

"In the long term, we are convinced this is a must for profitability, and we have never acted in the short term. If we fail to take care of this today, we will forfeit our opportunity to remain leaders of our industry."

ENVIRONMENT - In 1972, Volvo took a public position on the environment. The company declared its intention to make motor vehicles that "are used in such a way that they do not cause damage or injury. To be practical as transport units, they must also function in the widest perspective of the environment."

Volvo was the first company to fit three-way catalytic converters to its vehicles in the US in 1977. Developed by Volvo in collaboration with Robert Bosch of West Germany, it was the first converter capable of purifying nitrogen oxide emissions.

The company has also taken the important decision that environmentally-safe paint products and solvent-free undersealing compounds will, wherever possible, be used in all its products, thus further reducing emissions to the atmosphere.

TRAFFIC SAFETY - Early In 1990, a two-day conference of medical practitioners in Sydney heard that one million men and women could be injured and nearly 30,000 killed on Australian roads in the next 10 years.

Volvo has long been associated with the production of safe motor vehicles. Work by Volvo researcher Nils

Bohlin, in which he investigated more than 28,000 accidents, led Australian governments to legislate in 1969 for the compulsory wearing of seat belts.

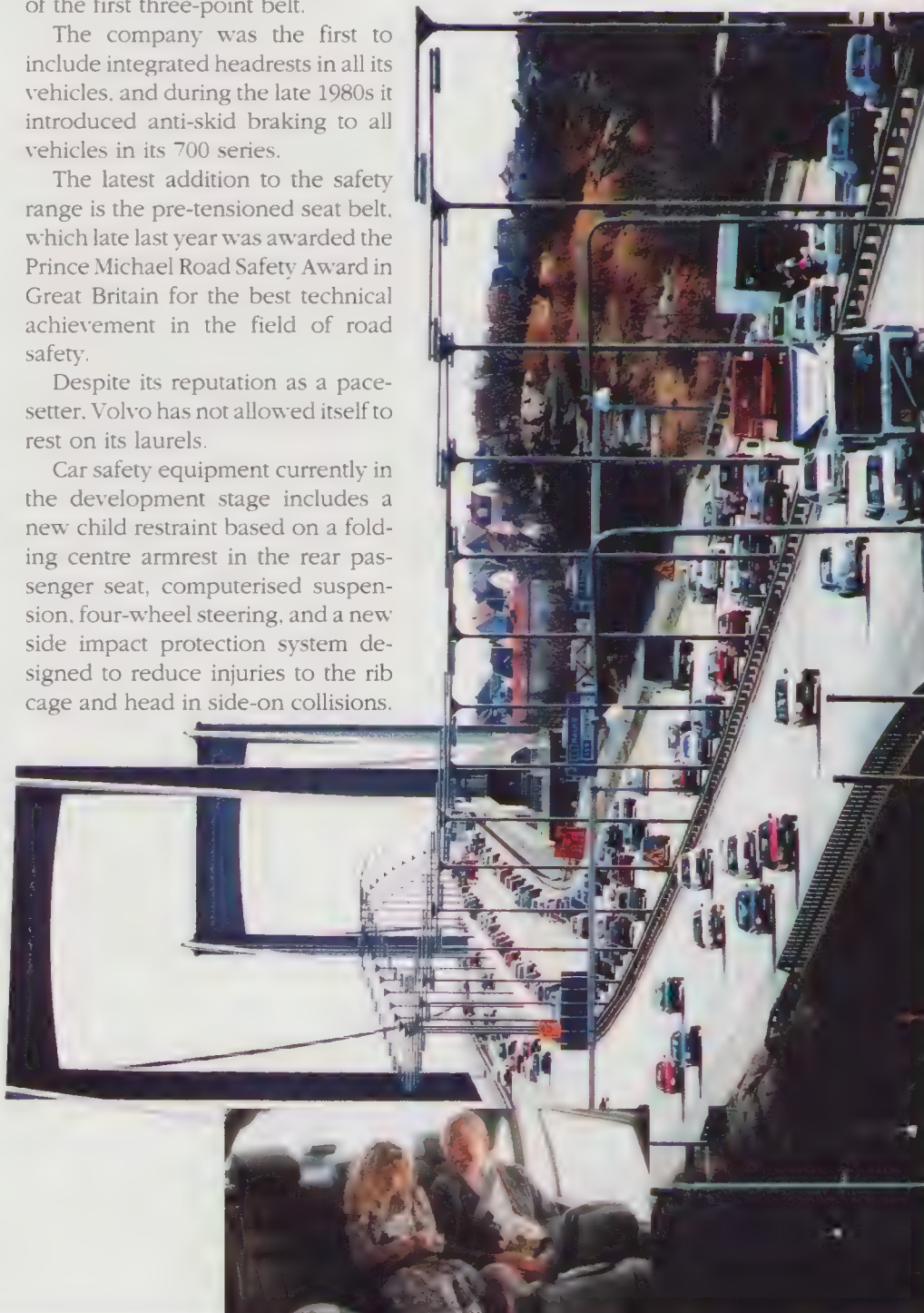
However, Volvo's commitment to road safety started much earlier than that. It began in 1944 with the safety cage and the laminated wind-screen. A major breakthrough occurred in 1959 with the development of the first three-point belt.

The company was the first to include integrated headrests in all its vehicles, and during the late 1980s it introduced anti-skid braking to all vehicles in its 700 series.

The latest addition to the safety range is the pre-tensioned seat belt, which late last year was awarded the Prince Michael Road Safety Award in Great Britain for the best technical achievement in the field of road safety.

Despite its reputation as a pace-setter, Volvo has not allowed itself to rest on its laurels.

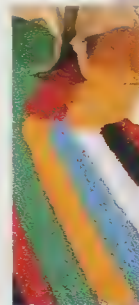
Car safety equipment currently in the development stage includes a new child restraint based on a folding centre armrest in the rear passenger seat, computerised suspension, four-wheel steering, and a new side impact protection system designed to reduce injuries to the rib cage and head in side-on collisions.



NYLON 5 FRAGMENT

MAIN

USFP



PLASTICS INDUSTRY ASSOCIATION

represents Australia's second largest, fastest growing, most dynamic manufacturing sector.

Over one million tonnes of plastics resin are processed in Australia each year — more than steel.

Not only is the plastics industry a huge employer, a successful exporter and an increasingly clever user of research and development, it is a building block for all other manufacturing sectors.

Plastic is a by-product of fossil fuels, mainly natural gas. The manufacture of polymers uses less than two per cent of Australia's fossil fuel consumption each year.

Plastics are efficient users of non-renewable resources. The development of a plastics recycling infrastructure will achieve even greater efficiency.

As well as a myriad of high-tech products, such as contact lenses, the bionic ear, the artificial heart, through to aeronautical and marine engineering, telecommunications cables, computer chips and cassette tapes, plastics are used in common and, these days, controversial applications like plastic supermarket bags and food packaging.

The turnover from the plastics sector in Australia is about \$7 billion a year and growing.

Plastics are highly efficient and reusable. Why then do some plastic products appear as a negative in

the environment debate?

This is a question that Plastics Industry Association put to itself over 18 months ago. The answer is, despite the many economic and social benefits of plastics, there are problem areas.

Increasing demands from environmentalists and the response of decision-makers to those demands justified a critical look at how the plastics industry was handling the environmental side of its activities.

That review resulted in the reorganisation and restructuring of Plastics Industry Association to develop constructive and effective responses to environment problems.

The approach is long-term, serious

'It is the responsibility of the industry to reclaim and reuse a substantial amount of the material it produces'

X-ROT

Y-ROT

Z-ROT

BOND-1

BOND-2

BOND-3

and consultative.

In February 1990, Sir Ninian Stephen, Australia's Ambassador for the Environment, launched PIA's "Looking Ahead" program. We announced then that we intended spending 12 months consulting widely on relevant issues involving plastics and the environment.

To that end, major seminars have been held in Brisbane, Sydney and Perth, and will be held in the other capital cities of Australia throughout the year.

Governments, regulatory agencies, environment groups, consumer groups, students and researchers are invited to contribute to the identification of problems and to the development of effective solutions.

As part of our initial information gathering exercise we have commissioned Monash University's Centre for Advanced Materials Technology to set up an international data base on plastics and the environment.

The data will cover technical, legislative and program information relating to recycling, degradability, energy use, litter control, the effects of mandatory measures, voluntary codes and any other useful experience.

Information from North America will come via the Council for Solid Waste Solutions in Washington. In the next few months we expect to gain access to the European data base on plastics and the environment based in Brussels.

The Environment Action Group, the management body comprising the companies that sponsor the "Looking Ahead" campaign, will fund industry-oriented research projects which help develop sustainable solutions.

In the area of plastics recycling, the EAG is funding a major feasibility project which will examine technical and economic aspects in a systematic fashion to provide a base for further recycling developments.

PIA already works closely with Australia's State and Federal governments, particularly on issues related to plastics recycling. During the next 12 months we plan to develop a network

to exchange information and co-operation with local government authorities throughout the nation.

PIA is also mounting national awards to raise the standard of plastics design, particularly in relation to the use of recycled plastics.

Recycling of industrial waste plastic is widespread throughout Australia. Recycling of post-consumer waste is another matter.

Up until now, very little has taken place in Australia because of the ineffective cost structure of collecting, cleaning, sorting, reprocessing and then reusing plastics that have been contaminated with food, mixed with other plastics or other materials.

Now, however, plastics recycling is moving fast.

The cost problems remain, but major players in the industry as well as some smaller entrepreneurs have decided that it is the responsibility of the industry to reclaim and reuse a substantial amount of the material it produces.

Looking at Western Europe and North America, it is clear that if this process is developed carefully it can, in the longer term, become commercially viable. PIA's environment strategy will support such develop-

ments wherever they occur and assist in the dissemination of information to assist new projects.

The "Looking Ahead" campaign is the first industry-initiated, comprehensive strategy for dealing with environment problems. It has been welcomed by governments throughout Australia and attracted favourable comment at Globe '90, the first international conference on business and the environment, in Vancouver in April 1990.

The use of plastic will become even more environmentally sympathetic.

Waste, in the sense of non-usable disposal, will be eliminated.

We foresee increased use of plastics in unique, high-tech applications through medical technology and engineering plastics.

A clever society will use plastics, particularly recycled resin, to reduce demand on forest and mining products, and contribute further to sustainable development.

The plastics industry is committed to the use of research and develop-

ment and improved training to obtain better productivity and better markets.

The industry has demonstrated its flexibility and responsibility by its speedy compliance with the Federal Government's requirements to eliminate CFCs in accordance with the Montreal Protocol.

INDIVIDUALS should lobby their local council to ensure both effective collection of used materials and the direction of those materials into the recycling process.

LOCAL GOVERNMENTS should work with ratepayers and industry so that plastic is collected, provided to companies, and reprocessed into usable items.

STATE GOVERNMENTS should purchase products that incorporate recycled material and ensure the enforcement of anti-litter laws on land, in waterways and at sea.

FEDERAL GOVERNMENT should remove sales tax from all products incorporating recycled material, should use its purchasing power in favour of products made from recycled material, and should develop policies that make the best use of our non-renewable resources.

ENVIRONMENTALISTS should inform themselves and the community about all environmental aspects of products and processes so that their efforts are constructive and well targeted.

INDUSTRY should invest in research and development, plant and equipment, and skilled labour, so that recycling can become a real solution to the disposal of used plastic.

ALL GROUPS should co-operate and work in partnership to achieve sustainable development.

The Plastics Industry Association Inc. formerly known as the Plastics Institute, represents more than 650 companies throughout Australia.

Corporate membership is available to any company which supplies, processes or manufactures polymers or provides machinery for the plastics industry. Associate membership is available to companies that make extensive use of plastic products.

Polymers are high molecular weight (i.e. very long) organic compounds. The human body is made up of many different kinds of polymers, mainly polypeptides [CHNO]. The images shown are several representations of a section of Nylon 5 polymer [C5H9NO]_n made up of carbon (grey), hydrogen (white), nitrogen (blue) and oxygen (red). These images are provided by Dr David Winkler and Dr Jonathon Hodgkin of the CSIRO Division of Chemicals and Polymers.

Left to right:

Recycled plastic garbage bin

Recyclable PET plastic bottle

Plastic granules used for manufacturing products

PIA

X-TRANS

BOND-4

NG

SCALE

IN 1975, WHEN only 60 per cent of Australian households had telephones, the main challenge facing the newly formed Telecom was to bring telecommunications within reach of all Australians.

Today 94 per cent of Australian homes have a telephone — an achievement few countries have matched.

Strange as it may seem, it was very difficult back in

1975 to interest people in the future prospects for telecommunications and how they might enhance their lives.

These days everybody recognises the vital importance of telecommunications in shaping our community and boosting the national economy.

In the 1980s, spurred by rapid technological

change, and changing customer requirements, people began to rediscover telecommunications. The 1980s was the decade of business communications, with growing international competition leading to spectacular developments in data communications, facsimile and mobile services.

Telecommunications has finally been recognised as a source of national wealth and a growth industry in terms of international trade.

Strong enterprise is now required if Australia is to maximise its opportunities in this burgeoning field. Which is one reason why Telecom has conducted a major internal "cultural revolution" over the past few years.

We restructured the corporation from top to bottom around the ethos of customer satisfaction and quality of service. These changes give us the capability and the will to respond effectively and confidently to future challenges.

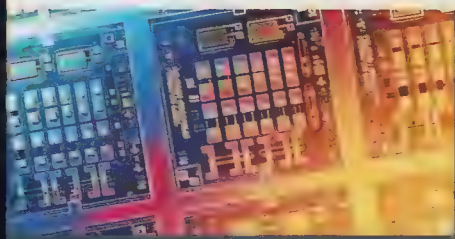
Telecom in the year 2000 will be very different from the Telecom we know today. Standing still has never been an option for us, nor for the dynamic and ever-changing telecommunications industry.

As technologies develop and customer requirements become more demanding, the primary challenge of the future is to steer a course which takes into account the commercial role of telecommunications, while pursuing the social goals of equity and universal access.

Telecom will meet this challenge through its own research and planning functions, by encouraging policy debate, and through direct interaction with consumer representatives.

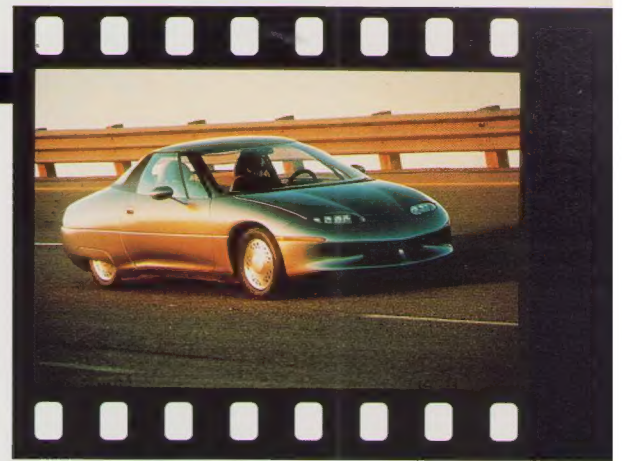
After all, we thrive on challenges.

'Telecommunications has finally been recognised as a source of national wealth and a growth industry in terms of international trade'



T e l e c o m A u s t r a l i a

'We recognise that our products and manufacturing processes must be in harmony with the environment'



GENERAL MOTORS HOLDEN is developing policies that work toward a healthier environment. From the global perspective — and that is the perspective that a trans-national company like General Motors must adopt — the environmental problems facing the world are many, complex and interrelated. They include

air quality, acid rain, ozone depletion, global warming and waste disposal.

General Motors recognises that these are serious concerns, and has adopted policies that reflect the international rather than the national interest alone.

We recognise that in Australia, as in any other part of the world, our products and manufacturing processes must be in harmony with the environment.

General Motors continues to make many significant contributions to a cleaner environment.

GM pioneered the development of the catalytic converter and the use of unleaded fuel to reduce engine exhaust emissions. The company also developed the computer command control system used today in GMH products to further reduce emissions.

GM continues to explore the use of alternative fuels such as methanol, ethanol, oxygenates, natural gas, fuel cells and hydrogen. The Impact concept car — the highest performing electric vehicle in existence — is the first with the potential to meet the safety standards for a production vehicle.

Research devoted to solar power culminated in GM's Sunraycer vehicle which won the 3000-kilometre Solar Challenge from Darwin to Adelaide in 1987.

The company is intensifying its efforts to find and phase in substitutes for chlorofluorocarbons in its products and processes.

The increased emphasis on environmental matters has fostered a wide range of proposals. There is no doubting that the complexities surrounding some of these issues will require new forms of consensus and co-operation among business, government and academia. Realism, responsibility and reason should combine to ensure that public visions for a healthy environment are achievable.



Wm J Hamel

Wm J Hamel Chairman and Managing Director General Motors-Holden's Automotive Ltd.



IMPACT ELECTRIC CAR

IMPACT, General Motors' latest development in electric vehicles, traces its bloodlines back to the 1987 Solar Race across Australia. This event was won by the world record-setting GM Sunraycer.

The Sunraycer wasn't just a solar car but an important exercise in battery, motor and aerodynamic efficiency. The Impact benefits from the Sunraycer's achievement in those areas.

Impact can accelerate from 0 to 100 kilometres per hour in eight seconds (quicker acceleration than many sports cars) and has a projected top speed of over 175 kmh. Impact has a maximum range of 200 kilometres between charges.

The Impact achieves its remarkable performance through new developments in electronics, motor design, structural materials, tyres and battery, coupled with careful attention to weight and aerodynamic and rolling design efficiencies.

Impact includes heating and air-conditioning, as well as other driver-passenger conveniences.

GM is well advanced with plans to produce and sell an electric-powered car for personal transportation use.

GMH is providing financial and vehicle support to Australian schools in the 1990 World Solar Challenge, the transcontinental solar car rally from Darwin to Adelaide in November.

The company has offered each school \$5,000 towards building its entry, as well as supplying two support vehicles during the running of the race.



THE HEYDAY FOR radio was supposedly in the 1930s when it provided the major mass entertainment for Australians. With the introduction of television in 1956, many of the quiz, comedy, drama and variety programs made the move to the small screen and radio became primarily a music and news provider.

Radio formats have remained much the same, with continuous-flow programming replacing the separate, one-hour or half-hour shows. FM transmission, introduced in the late 1970s, has been the major technical advance of the period.

Recording technology has advanced from shellac discs to multi-track tape recorders, digital audio tape machines and recordable compact discs. The 1990s bring audio stored digitally on computer hard discs and in solid state devices providing instant access to any item, as well as "non-destructive editing" where audio can be reassembled in any form, yet any or all edits can be "undone".

The next technical advance in the transmission area is digital broadcasting. This will supplant FM as the high-quality medium by removing all distortion from the signal and delivering at least CD quality stereo sound. No-one seems game to suggest trying quadrasonic sound again, so two speakers are here to stay.

Digital broadcasting will come in two forms — from conventional radio stations and from satellites. You will need a new radio receiver to pick it up, but these will be integrated into normal AM/FM models and new car aerials will allow you to pick up signals direct from satellites.

The frequencies digital radio will operate on will be resolved at an international conference in 1992, with broadcasts starting soon after. All the existing stations will broadcast digitally (well, those that can afford the technology), and from satellites there will be hundreds of choices available.

This means we are likely to see a number of specialist stations with news only, weather, traffic, sports, health and lifestyle, business and stockmarket reports, consumer information, shopping news, and any other sort of information for which there could be a demand.

Music channels would cater for all major music categories and all channels would be automated with information being constantly updated and the music channels responding to listener phone requests.

Satellite broadcasting will reach all of Australia; indeed, world-wide broadcasts will be possible, and this will lead to "narrowcasting", because there will be more signals available and they will each become narrower in the appeal of the program content.

To pay for these services, there will be advertising and, for some specialist services, a user-pays system debited direct to your bank account.

As a national network, Triple J will adapt well to a satellite-based digital broadcast system, because the technology will provide the Triple J signal to provincial and remote areas of Australia. Despite the range of radio resources available, **Triple J will remain viable because it focuses on the new in musical trends, as well as news, information and opinion**, and this unique mix is not provided by other operators, and probably would not be taken up by commercial services.

Report by the World Commission

on Environment and Development

on the critical environment pro-

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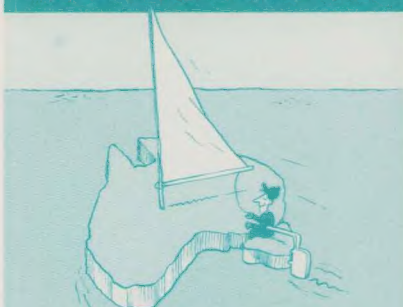
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